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OBSERVATIONS
ON THE
CLIMATE OF IRELAND,
AND
RESEARCHES
CONCERNING ITS NATURE FROM VERY EARLY PERIODS
TO THE PRESENT TIME,
WITH
THOUGHTS
ON
SOME BRANCHES OF RURAL ECONOMY,
PARTICULARLY RECOMMENDED IN
AN ADDRESS
TO THE INHABITANTS AND FRIENDS OF THIS COUNTRY.
TO WHICH ARE PREFIXED
PRELIMINARY CONSIDERATIONS
On the Structure and Functions of Plants.—On the Analogy between the Vegetable and Animal Systems.—On the general state of Woods and Plantations in Ireland, in ancient and modern times.—On peculiar circumstances denoting the various conditions of her Linen Manufacture throughout a series of ages.—And on the Utility of the co-operation of Art and Science in every Work wherein their joint labours are required.

BY WILLIAM PATTERSON, M. D.
MEMBER OF THE ROYAL IRISH ACADEMY, &c. &c.

> “ And God said, Let there be *Lights* in the firmament of the
> “ heaven to divide the day from the night; and let them be for *Signs*,
> “ and for *Seasons*, and for *Days*, and for *Years*. And God said, Be-
> “ hold, I have given you every *Herb* bearing seed, which is upon
> “ the face of all the earth, and every *Tree*, in the which is the fruit
> “ of a tree yielding seed.”
>
> Genesis, Chap. I. v. 14, 29.

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PRELIMINARY CONSIDERATIONS.

"Ever learn
"Quick æther's motion: oft the scene is turn'd;
"Now the blue vault, and now the murky cloud,
"Hail, rain, or radiance."

DYER.

SECT. 1.

METEOROLOGY, or the principles on which the properties of the atmosphere are unfolded and taught, is exalted into a *science*, and stands high in the scale of genuine philosophy. So it ought; since it certainly is applicable to useful purposes in life, the test by which the value of every branch of science should be tried. It is a branch indeed, which furnishes objects of the most interesting reflection, whether we consider it in respect to utility, or to the curious and sublime spectacles with which it abounds.

By the temperament of that great agent of nature, the atmosphere, the traveller endeavours to regulate his motions, and the farmer his labour; by it are modified health and disease; by it plenty, or famine, is dispensed; and by it, millions are furnished with the most essential treasures, the *prime necessaries* of life. Meteorology is the purest science of nature; it is the observation of the phenomena, with which we are surrounded; it is the contemplation of the agency of the elements,—an agency, which performs all the wonders in the theatre of creation; an agency, by which the grand system of the world is supported and preserved.*

This branch of physical knowledge, it is true, does not enable us to alter the spontaneous course of nature, except in a few cases, such as the alteration of temperature, by promoting or checking vegetation, draining morasses, &c. but, were it brought to that degree of perfection which appears possible, it would, like astronomy, empower us at least to foresee those changes we could not prevent. And, in candour, it is wrong hastily to set bounds to the progress, which they, who make the works of nature their study, may be competent to achieve in tracing the causes, which produce the alterations in the weather, as well as in foreseeing the successions of its changes.*

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* Jones's Physiological Disquisitions, Dis. IX. p. 552. Mills on the Weather. Adams on the Barometer. The invention of this instrument has been productive of many and important advantages to society. Along with the developement of the more secret and intimate qualities of the invisible fluid, the *Atmosphere*, the investigation of its more general and obvious qualities, its gravitation, density, and elasticity, by means of the barometer, brought about the greatest improvements in mechanics, astronomy, and consequently in navigation. It was the barometer which first suggested the invention of the *air-pump*, and thus paved the way for the numerous discoveries, to which this latter machine gave birth. Kirwan, Trans. R. I. A. Vol. II. Science, p. 43. To this distinguished philosopher, who has done so much towards unfolding the properties and explaining the laws of the atmosphere, science, society, and his country are largely indebted.

Ill founded predictions, and astrological conceits, may have raised unjust prejudices against a professed attention to the changes in the weather; but these prepossessions seem to be wearing out, and in due time will be expunged by the diffusion of sensible and scientific principles on the subject. Granting, for a moment, that meteoric inquiries are rather fanciful than solid, even in this point of view, like the labours of alchymy, they may be productive of considerable advantages, by suggesting new ideas and experiments, for doing which the various and extensive nature of such pursuits is well calculated. Astrology too, like alchymical operations, might sometimes furnish facts, which ought not to be despised, if reconcileable with physical laws, as observed by Lord Bacon, who sifted every thing closely, and judiciously separated the flour from the bran.†

With every branch of natural history the doctrine of the air is intimately connected, but with none more closely, perhaps, than with botany and agriculture. Our present imperfect knowledge of the

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* Kirwan on Latitudes, Preface, p. V.

† Mills on the Weather, Preface, p. VI. Bacon de Dignitat. et Augment. Scient. Lib. III. Chap. IV.

the physiology of living vegetables obliges us to have recourse to every help within our reach; and, growing plants being so immediately connected with the modifications of the atmosphere, *meteorology* is a source, from which much useful information may be acquired.*

SECT. 2.

THE vegetable economy is a curious and intricate subject, respecting which much still remains to be ascertained. Concerning the anatomy of plants, naturalists are very deficient; and of course they will be proportionably incomplete in explaining their functions. The most satisfactory system, that I have met with, on the structure of vegetables is one lately proposed by M. Mirbel, who seems to take several hints from Fordyce, Darwin, and other philosophers. He contends, that there are not any *true* fibres to be found in vegetables, the filaments, to which that appellation has been assigned, being nothing but membranes, detached in small longitudinal slips. The membraneous texture, though closely coherent in all its parts, forms two species of different organs, viz. the cellular texture and the tubulous texture. The cellular texture consists of a membrane, in the duplicature of which are hid interstices, contiguous to one another, which when not compressed have an hexagonal figure, but by any pressure from either side they receive the form of a parallelogram. The membranes of these cells are perforated with small pores, through which the juices are to pass. The exterior side of these cells is formed by the epidermis or scarf-skin, which, thus considered, is not to be taken for a particular membrane. The cellular texture occurs in the fleshy parts of plants, in the succulent fruits, the bark, the embryo, &c.

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* Templeton, Trans. R. I. A. Vol. VIII. p. 113.

The tubulous texture comprises two kinds of tubes, the large ones and the small ones. The large tubes are found in the cellular texture, and occupy the centre of the ligneous part in the single seed-leaves, and are sometimes spread without order in the wood of the double cotyledons; sometimes, however, they are distributed in regular groupes, and arranged in concentrical zones; they are not discovered in fungusses, lichens, and fucusses. He distinguishes four species of large tubes. 1. The *simple* tubes, whose sides are without pores; they contain the succi proprii or peculiar sap of plants, and are particularly numerous in the bark. 2. The porous tubes. Their sides are perforated like a sieve with many pores, which are arranged in regular and parallel rows; their use seems to be the same as in the first tubes. 3. What he denominates *false tracheæ* or wind-pipes, which are tubes transversely intersected with parallel openings or porous tubes, wherein the pores are larger than in the preceding species: they are mostly found in wood that is not very hard. 4. The *tracheæ* or true wind-pipes. These are tubes composed of threads or filaments, which are turned in spiral lines from the right to the left. They are observed in all the soft parts of vegetables. The tracheæ of the great flowering rush or water-gladiole, (butomus umbellatus), when unfolded, do not contract again. The distinction of these four species of tubes, however, is by no means so exact as not to admit of exception; thus the butomus offers, in the same tubes, the pores of the porous tubes, the openings of the false trachea, and the spiral windings of the true trachea. These tubes the author distinguishes by the name of *mixed tubes.*

The small tubes are composed of cells united with one another, which are closed at their extremities; their walls or partitions are frequently provided with pores; in the embryo they are not yet evolved; they may be observed in some lichens. Placed round the large tubes, they make the ligneous filaments in the single seed-leaves (monocotyledons); and in the double seed leaves (dicotyledons), being arranged round the marrow and the large tubes, they compose the ligneous strata; they frequently fill and obstruct the large tubes.

He gives the name of *lacunæ* to regular and symmetrical interstices, which are formed in the interior of vegetables by the division of the membranes, a phenomenon which is particularly observed in plants of a lax texture. In the horse-tail (equisetum), they are remarkably regular; one being larger than the rest, forms a duct in the centre of the stalks, while two rows of small ones surround the central tube; in the leaves of the single cotyledons the lacunæ are intersected with partitions visible to the naked eye, consisting of cellular substance. These membranaceous organs may be a kind of folliculose vessels ending in those lacunæ or mouths. It is believed, that from these lacunæ the large tubes originate.

Though *glands* are not perceptible in vegetables, M. Mirbel thinks that they may be supposed to exist in the membranes, as sap is secerned and elaborated in them. It is not improbable, he says, that the darkish wreaths, which surround the pores and the orifices of the large tubes, are of a glandulous nature. The pores are small openings in the membranes, of which three species may be distinguished:—1. The *insensible* pores, which cannot be perceived, but seem to be the organs of the insensible transpiration. 2. The *elongated* pores, or the organs described by the name of cortical pores, each of which corresponds to a cell; they serve for the transpiration and absorption of fluids; their seat is the cuticle of the herbaceous part. 3. The *glandulous* pores; these are openings surrounded with opacous irregular wreaths; they occupy the interior, and sometimes the exterior parts of plants. They are either very minute, or larger, in which latter case they seem to be formed by the union of the smaller ones.

All parts of vegetables, he believes, are originally mucilaginous; thus the embryo is, at first sight, nothing but a mucilage, very similar to the white of an egg. This mucilage is remaining at the interior bark (alburnum), called by some sap-wood, and at the medulla or marrow in the double seed leaves, also placed round the woody filaments in the single seed leaves. From this mucilage, the cellular as well as the tubulous texture seem to have birth. He observes, that the embryo adheres to the mother plant by means of an umbilical cord, which has a peculiar construction. In this manner, Mirbel endeavours to explain the vegetable organization; but he, at the same time, remarks how comparatively inconsiderable is the progress hitherto made in the knowledge of the anatomy of plants.*

The *seed* is a deciduous part of a vegetable, containing the rudiments of a new plant. It consists of the *heart*, *seed-lobes*, *eye*, and *seed-coat*. The heart or corculum, called also *embryo*, is that part, which is the future plant in miniature, and consists of a *radicle* or descending portion, and a *plumule* or ascending portion. The seed-lobes, named also *cotyledons*, are one, two, or three masses of farinaceous matter, and are the perishable part of a seed, designed to afford nourishment to the young plant, when it first begins to expand. A bean, deprived of its skin, and divided into two, shews the seed-lobes. The eye is the external scar upon a seed, by which it was fixed to the seed-vessel; it is very remarkable in a bean. The seed-coat is the proper coat of the seed, which falls off spontaneously. The embryo lies in a dormant state, that is, lives, but not exerting its life until it be put into proper circumstances for the exercise of its functions. When the seed is adequately situated for growing, the farinaceous or mealy substance in the cotyledons is converted into sugar, the embryo swells, and the radicle pushes forward, till it get through the seed-coat, after which it descends perpendicularly, until it branch out into fibres.

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* This is an extract from a memoir presented to the National Institute of France about two years ago. With respect to the tubes nd cells represented by Mirbel, they are mentioned by Fordyce, ements of Agriculture, Part III. p. 72—3. 1789. The trachea, da, umbilical vessels, medulla, &c. are treated of by Darwin, ia, from Sect. I. to VIII.

When the radicle has gotten into the earth, the plumule rises upward; sometimes bringing with it the cotyledons, which are in certain cases converted into seed-leaves. During this time, the plant is nourished principally by the cotyledons; for if the root be destroyed, the plumule will rise up, and when it gets above ground, and its leaves spread, fresh roots will be thrown out.

If a plant be cut off below the cotyledons, it will hardly ever push out fresh leaves, but rots and is lost; on the other hand, if it be cut off above the cotyledons, it generally shoots afresh, and continues to grow; therefore, if plants, whose cotyledons come above ground, as turnips, be cut or ate to the ground by any animal, they decay; but if those, whose cotyledons remain below ground, the grasses, for example, be cut, they will spring forth anew.*

All plants, according to the Linnæan system, have male and female organs of generation. The former organ is called *stamen* or *chive;* the latter, *pistil* or *pointal.* The stamen consists of a *filament* or stalk, an *apex* or *anther*, and the *pollen*, dust or farina proceeding from the anther. The pistil is composed of a *germ* or seed-bud at the bottom, a *style* or stalk, and a *stigma* or summit. The plant is placed in a *class* according to the number of its male parts, and if one stamen the class is denominated *monandria*; the *order* is regulated by the number of female parts, and if one pistil, it is termed *monogynia;* and so on agreeably to the number of each organ; or otherwise adjusted in consequence of certain deviations and anomalies.

The *blossom*, or corolla, is that beautifully coloured part of a flower, which commands the attention of every person. If it be entire and undivided, as in the polyanthus, or auricula, it is termed a blossom of *one petal;* but if it be composed of several parts, it is accordingly said to be a blossom of *one*, *two*, *three*, &c. or many *petals*. Thus the blossom of the tulip is formed of six petals; and garden roses bear blossoms composed of many petals. The blossom is supposed to be an expansion of the inner bark of the plant.

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* After the plumule tops the ground in the grasses, there is a knot or swelling, formed above the cotyledons, where the stem emits several branches and fresh roots; and as soon as the leaves of these spread, the first root dies: this is called *tillering*. These branches are more or less numerous, according to the richness of the soil; the tenacity of it; the room the plant has to grow in; the moisture of the ground; and the earliness of the season. Fordyce, Elem. Agric. Part III. p. 77, 78.

The production of perfect seed is the obvious use of the flower; and for this purpose the fine dust or meal, that is contained in the tips or apices, is thrown upon the summit or stigma of the pistil: this summit is moist, and the moisture, acting on the particles of the dust, occasions them to explode, and to discharge a very subtile vapour. This vapour, passing through the minute tubes of the pistil, arrives at the embryo seeds in the seed-bud, and fertilizes them.*

The analogy to animal procreation, supposed to take place in this curious process of the vegetable race, was a few years ago, (1797 or 1798) demonstrated in a species of river-weed (*conferva jugalis*), collected in the neighbourhood of Paris. It was ascertained by means of an excellent microscope, that in this plant there are male and female filaments, which unite by an actual copulation; that certain globes contained in the male filaments pass into the interior part of the female filaments; and that, by this union, in the latter are formed seeds, or, if we may use the expression, small *ova*, which reproduce the species.†

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* Withering's Botanical Arrangement, Introduction, page 18, 22.

From the practice, called *budding* or inoculation, it may be inferred that every bud of a tree is an individual vegetable being; and consequently that a tree is a family or swarm of individual plants, like certain animals, with its young growing out of its sides. From observations on decaying trees also it appears, that no part of the tree is alive but the buds, the bark, and the root-fibres; and that the bark is only an intertexture of the caudices, or bodies of the numerous buds, as they pass down to shoot their radicles into the earth. Hence it seems that a bud of a tree, like a vegetable arising from a seed, consists of three parts; the plumule or leaf, the radicle or root-fibres, and the part which joins these two together. This, when applied to entire plants, is termed by Linnæus the *caudex*, and by Darwin *caudex gemmæ*, or body of the bud.

The buds producing flowers are each an individual being, as well as the leaf-buds, though it is probable, that they are not so easily capable of being planted by inoculation in the bark of other trees. Nor does the existence of many male and female parts in one flower destroy its individuality, any more than the distinct existence of a sow or a bitch is annulled by the number of paps in the dug, or by the number of their cotyledons, each of which, during gestation, belongs to separate fœtus. Hence he concludes, that an embryon bud, whether it be a leaf-bud, or a flower-bud, is the viviparous offspring of an adult leaf-bud, and is as individual as a seed which is its oviparous offspring. It consists, first of a central organization or caudex, like the corculum or heart of a seed, which contains the rudiments of the several tubes, filaments, &c. necessary for carrying on its progressive functions.

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† Philosophical Magazine, Vol. I. p. 306, 307. When the leaves and stem of a plant flourish greatly, it seldom produces many flowers. In grasses, as the nourishment is drawn from the roots after flower, if the roots are rotted by moisture, the seeds will not fected. Fordyce, Elem. Agricul. Part III. p. 81.

As the internal pith of a bud is believed to contain or produce the living principle of a plant, like the brain and spinal marrow of animals, it is thought that we have hence a certain criterion to distinguish one bud from another, or the parent bud from the numerous budlets, which are its offspring, as there is no communication of the internal pith between them.

The seeds of plants are thus a sexual progeny, claiming both a father and mother, whilst the buds are a linear progeny, produced and nourished by a father alone, to whom they adhere, not falling off like the seeds. For in this most simple kind of vegetable reproduction, not only by buds, bulbs and wires, which are their viviparous generation, the caudex of the leaf is the part of the bud, or bulb, or wire, which rises into its bosom. This paternal race exactly resembles its parents, when it has arrived at its maturity; whereas the seminal race, since it derives its form partly from the mother, and partly from the father, is liable to perpetual variation; both which dispositions are employed by skilful gardeners to great advantage.

Dr. Darwin contends, that the leaves are neither perspiratory, excretory, nutritious, electric, nor luminous organs; but are the lungs of plants, and contain an appropriate apparatus for the function of respiration. This function, according to him, is performed by the upper surface of their leaves, on which the sap is exposed in the termination of one set of tubes, beneath a thin moist pellicle, to the action of the atmosphere, which converts it into vegetable blood, and this is collected there by another set of vessels or tubes, which return it to the foot-stalk of the leaf. At the same time it is to be observed, that the upper surfaces of the leaves exhale much less than their under surfaces. There is still another pulmonary system totally independent of the green foliage, which belongs to the parts of fructification only, that is, the corals or petals.*

Whether plants have nerves and muscles, whether they are endowed with sensation, volition, and association of motion, I shall not pretend to determine; but from the various motory impulses, exhibited by peculiar parts of vegetables, it is certain that they possess an inherent power of action, which, for want of a better appellation, I shall here denominate *irritability*. This faculty has been considered by some philosophers as residing in a nervous influence, resembling what takes place in the muscular and other motions of animals, and thence termed *true* irritability; whilst others explain the mobility of vegetables on mechanical principles, denying that they inherit any sort of spirit of animation.

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* Darwin's Phytologia, Sect. I. II. III. IV. VII.

Van Marum, Hildebrant, Darwin, and other philosophers think that there is this *real irritability* in plants, and particularly in those which have spontaneous kinds of movement. It has thence been asserted, that oxygen has the same effect upon those plants called sensitive, as it has upon animals. On the other hand, Peschier made several experiments to ascertain whether this opinion was well founded; but to him it never appeared, that oxygen produced any effect on those plants. He afterward examined whether these movements of those plants, viz. the sensitive, are owing to *real irritability*, like that of animals; the numerous experiments, which he made on this subject, gave him reason to conclude, that no real irritability could be ascribed to those plants, and that all the movements they experience, by the simple touch or otherwise, are merely mechanical; and, in fact, notwithstanding modern skill and acuteness, it has not been discovered that plants have either nerves, or muscles, or any organs analogous to those, which, in animals, appear to be the seat of irritability.

Lamark endeavours to explain this property by observing, that in the articulations of many plants, and in certain parts of them, particular vesicles exist, which, especially in warm weather, become filled with elastic and very subtile excretory vapours. These vapours, which are to a certain degree accumulated and retained in the vesicles, swell them out, and make them produce an extension in all the moveable parts, where they are situated; but, on the least shock of agitation, the elastic and subtle vapours, which fill these vesicles, escape, and are exhaled into the atmosphere. The vesicles being thus emptied shrink; and the vegetable part, which is not preserved in its extended state, shrinks also, and falls back into the articulation where the vesicle was placed. Soon after the vesicle becomes filled again, though in an insensible manner, and still produces an extension of the leaf-stalk or petiole, which a cause like the preceding might destroy.

In the *hedysarum gyrans*, or sensitive hedysarum, the vesicles of the bottom of the small leaves, being filled to a certain degree, then empty themselves insensibly, become filled again as before, and re-empty themselves in like manner, without any other determining cause than the effect of their plenitude. But this continued alternation of repletion and evacuation keeps in constant movement the small leaves of the plant, which, when the weather is warm, rise and fall alternately, yet in a slow manner.

Shade, or the absence of light, by the coolness resulting from it, causes that evacuation or shrinking of the vesicles just mentioned. Hence he accounts for the closing up in the evening of certain parts of plants, especially of the leguminous families, to which botanists have given the name of *their sleep*. By these causes, or others analogous, he thinks that all the movements of the sensitive tribe of plants ought to be explained. A great number of plants experience likewise particular movements in the sexual parts at the time of their fecundation; and these movements, he conceives, must be produced by an *aura seminails*.

Dutrouil ascribes the irritability of plants, and the consequent movements, to their organization. He believes that the motion of the sensitive plant, when touched with the finger, proceeds from the action of the electric fluid, and from the sudden disengagement which is produced, when put in equilibrium. He attempts to confirm this explication, by observing that, if a plant be touched by a body, which is not proper to transmit the electric fluid, this movement will not take place. Light occasions the same effect on the plant as the contact of the finger, by reason of the electricity that is demonstrated to exist in that agent.

Afterward he disputes the consequences, which some naturalists draw from the approximation of certain parts of the plant at the period of fecundation, (namely, an intrinsic sensibility), by assigning to this approximation a cause purely mechanical. He does not admit in plants the faculty of perception, except it be that of feeling; and he grounds his opinion on the little analogy existing between their organization,

and

and that of the beings wherein this faculty resides, and which they only owe to it. In short, the question of vegetable physiology, whether the sensibility, with which certain plants appear to be endued, is purely mechanical, or has any analogy with animal sensibility, he resolves in favour of the former origin.*

These physiological theories, propounded by Peschier, Lamark, and Dutrouil, which seem tending to the same mechanical principles, cannot be construed nor understood otherwise than by supposing, that the phenomena, which they represent, are produced by the agency of light, heat, air, electricity, and moisture on the bases of the gaseous fluids contained in the juices of plants. The juices constitute by far the greatest part of an herbaceous vegetable, as the minute threads, which compose its solids, are reduced to a very slender parcel, when the juices are completely extracted by art.† Hence the operations wrought by the above active agents on the vegetable juices, in proportion to the quantity of each ingredient they contain, will have a greater or less influence on the small filaments, and occasion the various movements ascribed to the plenitude, bursting, shrinking, &c. of vesicles, to other mechanical causes, or to the equalization of electrical powers.

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* Philosoph. Magaz. Vol. I. p. 305, 309. London Medic. and Physic. Journal, Vol. 9. p. 291.

† So great is the quantity of fluid existing in plants, that many roots are known to lose six parts out of seven of their original simply by drying them before the fire.

With respect to vegetable nutriment, we find that a plant will grow in sand alone, moistened with pure distilled water, and in the purest air, but not so luxuriantly as in a rich soil. A plant will also grow better in a mixture of sand and clay, where the tenacity is adapted to the energy of its root, than in sand alone; and it will, moreover, grow better, if a proper quantity of water be applied, conformably to the disposition of its roots to resist putrefaction; but, with both these advantages, it will not flourish so well as in a rich soil. If, in a proper mixture of sand and clay, a plant be suitably supplied with water, it will grow better than in the same mixture exposed to the weather, and the chances of being too moist or too dry; but it will grow still better in a rich soil. There is, therefore, in a rich soil something independent of texture, or the retention of water, which contributes to the flourishing of plants; and what that nutritive something is, may be deduced from the following observations:*

The food of young vegetables is derived from the production of sugar by germination. The embryon plant in the seed or fruit is surrounded with saccharine, mucilaginous, and oily materials, which it absorbs, and converts into nutriment; while the embryon buds of deciduous trees, which is another infantine state of vegetables, are supplied with saccharine and mucilaginous juice, prepared for them at the time of their production, and deposited in the roots,

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* Fordyces' Element. Agricul. part IV. P. 85, 86.

roots, or sap-wood, of their parent tree; for example, in the vine, maple, and birch. This saccharine matter is soluble and miscible in the water of the surrounding earth in the subsequent spring, and is forcibly absorbed by their root-vessels, expanding their nascent foliage.

The food of adult plants is derived from the spontaneous decomposition of vegetable and animal bodies, or from air and water alone. The elementary matter called *oxygen*, combined with heat, constitutes that part of the atmosphere, which is perpetually necessary to vegetable respiration, or that function denominated respiration, from its being essentially contributive to vegetable life. Oxygen also forms a greater part of that water, which composes a principal portion of the organization of plants. The union of oxygen and heat is called oxygen gas or vital air; and with this solution of oxygen in heat, light also seems to be joined.*

The agency of *water* in the process of vegetation has never been doubted, though the manner in which it acts was not distinctly perceived, until within these few years past. Besides being the vehicle for distributing the nutritious parts throughout the structure of plants, water forms a constituent part of them all. Ingenhowz and Senebier, followed by others, have shewn, that the leaves of plants exposed to the sun, produce pure air; and it is proved, that water contains about 87 per cent. of oxygen air, the remainder or 13 parts, being hydrogen gas. By the assistance of light, water is decomposed within the vegetable; its hydrogenous part is employed in the formation of oils, resins, gums, &c; its oxygen air is partly applied to the production of vegetable acids, and partly expelled as an excrement. It has also been supposed that the hydrogen of the water, by its union with azote, may produce ammonia; which may contribute to vegetable nutriment, by its mixture with oils, and thus forming soaps that become diffusible in water.*

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* Darwin's Phytologia, Sect. X.

Water, indeed, has been considered so prime an agent in the vegetable economy, that many observers have asserted that it is the *sole* food of plants; and the celebrated experiment of Van Helmont, made with the trunk of a willow, has been urged as an *argumentum crucis*, in establishing the opinion. But, from a judicious examination of the circumstances attending that experiment, Mr. Kirwan has made it appear that the rain-water absorbed by the tree, contained as much earth as the tree could be supposed to contain.†

When animal and vegetable bodies are burnt without access of air, there remains a great quantity of charcoal or oxyd of *carbon*, a much greater in the latter than in the former; and, as vegetables contain so much of it, they may be supposed to absorb it entire where they grow vigorously. At the same time, they may possibly form it occasionally from water and air within their own vessels, when they are secluded from access to it externally. The importance of the carbonic substance or coal, to the nourishment of all vegetables, will be still more evident when we consider, that it is one of the primæval principles of our globe; for it is found in carbonic acid gas, of which it constitutes above a fourth part; and this gas exists in lime-stones and other substances, which date from the first origin of things. Coal is likewise the residuum of all putrid vegetable and animal substances, is found in this state in vegetable and animal manures, that have undergone putrefaction, and is the true basis of their ameliorating powers.*

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* Kirwan, Trans. R. I. A. vol. 5, Science, p. 148, 150. The emission of pure air by plants in the light, is not without an exception; for Humboldt has observed, that mushrooms furnish hydrogenous gas in the day, as well as in the night time.

† Id. p. 150—53.

This discovery of Horssenfraz, so well illustrated by Mr. Kirwan, has been confirmed by Mr. Rafn, of Copenhagen, who has also shewn that the carbonic acid has the same effect as carbon in the nutrition of vegetables. In illustration of this doctrine, we may observe, that Saussure the son found that plants growing in a calcareous soil, contain less water than those in a granite soil; that charcoal was more abundant in the former than in the latter; and that a similar difference takes place with respect to calcareous matter, in the ashes of the vegetables produced from those soils. Hence he infers, that a soil has an influence on vegetables, independent of its power to retain water; and that, in point of solidity, the wood of calcareous countries is preferable to that of granatic countries.

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* Kirwan observes, that 105 pounds of rotten cow-dung contain 120 cubic inches of carbonic acid gas, and 1360 cubic inches of carbonated hydrogen gas. Proust found that green oak yields of charcoal 20 per cent; wild ash 17; willow 17; white ash 17; pine 20; heart of oak 19; guaiacum 24; and black ash 25.

Long before Rafu's experiments, it had been found that fixed air imbibed by the roots of plants, is favourable to their growth; whilst on the other hand, they do not thrive, but most frequently perish, when they are surrounded by an atmosphere of fixed air. The manner in which this air, or carbonic acid gas, acts in promoting vegetation, is satisfactorily explained by Senebier, and his explanation is adopted by Mr. Kirwan and the best modern philosophers. Ingenhouz, Senebier, and others, as already observed, have shewn the effects of the solar rays on the leaves of plants; and Senebier first discovered, that fresh leaves, exposed to the sun in spring water, or water slightly impregnated with carbonic acid gas, always produces pure air, as long as this impregnation lasts; but as soon as it is exhausted, or if the leaves be placed in water, out of which this gas has been expelled by boiling, they no longer afford pure air; whence he infers, that the carbonic acid gas is decomposed, its fixed principle or carbon retained by the plant, and its pure air or oxygen gas expelled.

Mr. Kirwan thinks that it likewise operates in another manner, namely, by acting as a stimulant, and thus assisting the decomposition of water. The carbonic acid gas is liberated by the motion of the sap in the roots, and by agricultural processes, which bring the vitriolic acid, contained in various clays, into multiplied contact with calcareous earth; also that portion of this earth, which is by water introduced into the plant, is decomposed, and its air set loose by the vegetable acids of the plants. Nay, that this gas contributes largely to the support of plants is evinced by these facts, namely, that their solid fibres consist chiefly of carbon, and their fluids of water.*

Besides the use of oxygen in the respiration of vegetables, as before mentioned, when applied to their leaves in its mixed atmospherical state, it appears to contribute much to their growth and nourishment, when absorbed by their roots in a state of combination. Since Humboldt made the experiments in 1793, which led to this discovery, many philosophers have zealously pursued the subject, and have illustrated and confirmed his results. He found, that in the oxymuriatic gas, diluted with water, cresses (*lepidum sativum*) germinated in six hours, but in common water, not until the end of thirty-two hours. He afterward discovered, that, by joining the stimulus of caloric to that of oxygen, he was enabled still more to accelerate the process of vegetation.

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* Kirwan, Trans. R. I. A. vol. V. p. 164. Darwin's Phytologia, Sect. 10.

The same unwearied and intrepid philosopher, since he began to explore the terrific and interesting regions of the New World, has discovered in the interior vessels of the *clusia rosea*, a species of balsam-tree, an immense quantity of air in circulation. This air he found to contain as much as 35 cents of oxygen. The leaves of the same plant, exposed to the sun under water, gave out but a very small portion of pure air. The air which thus circulates in the plant, he believes, is recently produced by the organs appropriated for the decomposition of water, and serves, by the abundance of its oxygen, to precipitate, or coagulate, the fibrous matter for the formation of the cellular tissue.

The influence of oxygen on the germination of plants, is at once extremely powerful and curious.

Professor Pohl, at Dresden, caused to germinate in oxygenated muriatic acid, the seed of a new kind of euphorbia, 110 or 120 years old, taken from a collection of dried plants. Jacquin and Vander Sechott, at Vienna, threw into oxygenated muriatic acid, all the old seeds which had been kept twenty or thirty years at the botanical garden, in which every previous attempt to produce vegetation had been fruitless, and the greater part of them were successfully stimulated. Even the hardest seeds yielded to this agent; and the ligneous as well as the herbaceous, sprang at its authority.

By repeated trials, Sir Francis Ford found that flowers, and other plants, sprinkled with water that had been previously impregnated with oxygen gas, grew much more vigorously, and even displayed more beautiful tints, than similar plants on the same ground, treated with common water. Besides sprinkling the plants with oxygenated water, the application of oxygen to promote vegetation has also been tried in the following simple manner, and the result has been the same. Bottles filled with oxygen gas, being first inverted, had their mouths buried under ground, near the roots of the plants intended to be supplied with it. After some time, the gas in the bottles was found reduced to the standard of common atmospheric air: but the oxygen had done its duty; for the plants that had been thus supplied with it were much more healthy and beautiful than others of the same kinds, placed in every other respect, in similar circumstances.

For the purpose of expediting the germination of seeds, Humboldt employed the following process, which seems likely to be much easier to gardeners, who have not an opportunity of procuring the oxymuriatic acid: he formed a paste, by mixing the seeds with the black oxyd of manganese, and then poured over it the muriatic acid diluted with water. Three cubic inches of water were mixed with half a cubic inch of the muriatic acid. The vessel which contains this mixture must be covered, but not closely shut, else it might burst. At the temperature of 95° the muriatic acid becomes strongly oxydated; the oxygenated muriatic gas which is disengaged, passes through the seeds ; and during this passage, irritation in the vegetable, or chemical change in its juices, takes place. *

Azote or nitrogen, which in the atmosphere exceeds oxygen, in the proportion of 73 to 27, seems also to contribute to the aliment of vegetables. For though azote or nitrogen is thought to enter into animal bodies, in much greater quantities than into vegetables, so as to consitute, in the opinion of some chemists, the principal difference between these two great classes of organized nature ; it nevertheless is received into the composition of living vegetables, and is given out by their putrefactions. Also, when lime is applied to moist vegetables, it disengages from them both hydrogen and azote, forming volalkali, (ammonia), as stated by Lord Dundonald.

Dr. Darwin believes that *phosphorus* is another material which exists universally in vegetables, and regrets that it has not in this case been sufficiently attended to. Being probably a simple substance like carbon, hydrogen, and nitrogen, he thinks it may be taken up entire, by the absorbent vessels of vegetables, when it can be met with, in a state of solution. It may likewise, he further thinks, be occasionally formed and secreted by them ; and hence that it may be included among the articles of their food or sustenance. These conjectures have been lately realized by the experiments of Vauquelin, who discovered phosphate of lime, in several kinds of corn. This fact tends to prove the analogy of the chemical processes in the animal body, with those in the vegetable organization, as such a combination had been hitherto only found in the bones of animals.†

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* Kirwan, Trans. R. I. A. Vol. V. p. 161. Philosophical Magazine, Vol. I. p. 309, 311. Darwin's Phytologia, Sect. X. XIII.

Earth is a very important ingredient in the nourishment of plants; and of the different earths, the *calcareous* seems the most necessary, as it is contained in rain water; absolutely speaking, indeed, many plants may grow, without imbibing any other. The actual quantity of earth in vegetables is very small; and none of the earths can enter into plants except in a state of solution, or at least only when suspended in water, in a state of division as minute as if they had been really dissolved.

Saline substances (gypsum and phosphat of lime excepted) seem to serve vegetables as they do animals, rather as spicy promoters of digestion, than articles of nutriment. This opinion arises from observing the smallness of their quantity, and the offices they are known to perform. Their quantity is always smaller than that of earth, and this is found to be exceedingly small. Thus, one thousand pounds of fir give only forty-five parts of a pound of saline matter. The same weight of fumitory gives 79 pounds, which is the largest proportion that has come within the sphere of my knowledge. The proportion of saline matter to that of the earthy, has hitherto been found smallest in woods. In other plants, generally as 1 to 1, 3—1, 5—or 2. However, there are some exceptions; for instance, *hemp* and *flax*, in the former of which, the saline substances are to the earthy, as 1 to 8, and in the latter, as 1 to 1, 7 nearly.*

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† Med. and Physic Journal, Vol. IX. p. 584. Darwin's Phytologia, Sect. X. For the use of lime, calcareous earth, clay, nitre, sea salt, metallic oxyds as manures, together with manures by spontaneous and chemical decomposition, see same work, same section. Azote, or nitrogen is by Dr. S. L. Mitchill, a distinguished American chemist, called *Septon*, or the principle of putrefaction. Seing that phosphate of lime is found in plants, and that hydrogen enters into their economy, have we thence a ray to guide us, in commencing an investigation respecting a hint I started, above a year ago, on the share which phosphorized hydrogen gas might have, in imparting to vegetables their green colour? Transact. R. I. A. Vol. VIII. Science, p. 266. Phosphate of lime is analogous to the earth of bones, and is an ingredient in human urine; both which materials are useful manures.

That *light* and *heat* are two distinct subtile fluids, is proved by observation and experiment. It is found, that the rays of light can go through certain substances when heat cannot, and that the emanations from heat may be transmitted through certain substances without light. Heat possesses also reflexibility, independent of light. Besides, light and heat are seldom, if ever, associated in equal quantities, for sometimes the one and sometimes the other, is observed to predominate. Therefore, as there is a difference in the refrangibility, in the reflexibility, and in the assembled quantities of light and heat, these two sorts of rays, the *luminous* and *calorific*,

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* Kirwan, Trans. R. I. A. Vol. V. p. 164, 5. In the same memoir, are excellent methods, laid down for discovering the constitution of fertile soils, for estimating their fertility, and for determining the composition of any particular soil.

calorific, must be distinct things, and two separate powers of nature.*

The water perspired by plants, when exposed to the sun-shine, appears to be decomposed, in its escape from the fine extremities of their exhalent or perspirative vessels; and by the mouths of these vessels, the hydrogen is re-absorbed. That this happens to a certain degree, is evinced by *etiolated* or blanched vegetable leaves becoming green, when exposed a few days to the sun-shine; which is believed to arise from their retaining the hydrogen of the water they perspire, as it is decomposed by the sun's light. Their natural colour being blue, the addition to hydrogen communicates yellow to this blue, and converts them into green, which Dr. Darwin calls *tanning*.†

There is reason to believe, that on a sunny morning, much pure or oxygen air becomes separated from the dew, by means of the points of vegetables, upon which it adheres, and that much inflammable or hydrogen air is imbibed by the vegetable, or is combined with it. On the sun's light, thus decomposing water, the effects of it in bleaching linen and cotton, seem to depend; the water is decomposed by the light, at the ends or points of the fibres on the surface of the cloth; the oxygen air, uniting with the phlogistic or colouring matter of the fabric, produces a new acid, which is either itself colourless, or washes out; and at the same time the hydrogenous part of the water escapes.

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* Philosoph. Trans. 1800, Part III. Art. XIX. Mr. Kirwan considers light to be a modification of caloric or heat, that is, an homogeneous arrangement of some or all its constituent particles, which, when thus arranged, and then only, become *visible*.

† Fordyce's Elements of Agriculture, Part III. p. 84. I have elsewhere observed the effect of the external decomposition of water, in communicating the green colour to vegetables. See Trans. R. I. A. Vol. VIII. p. 259.

The avidity for light, which is so visible in the growth of vegetables, shews that it is of great consequence to their existence. Thus many flowers, the sun-flower for example, follow the sun during the course of the day; and the leaves of all plants endeavour to turn to the light their upper surface, which is their lungs, as already observed; thereby procuring for their respiratory organ an atmosphere more replete with vital air. So great, indeed, seems to be the necessity of light to the respiration of vegetables, that there is cause to conclude, many plants do not respire during the night, but exist in a torpid state, like winter-sleeping insects. Thus the sensitive plant, *mimosa*, and many others, close the upper surfaces of their opposite leaves during the night, hereby precluding them both from air and light. The internal surfaces also of innumerable flowers, which are their respiratory organs, shut up during the night, by which the access of both those elements is prevented. The fungi, nevertheless, which are classed among vegetables, can exist without light or much air; as is perceived in the truffle, which never appears above ground; in other fungi, which grow in dark cellars; and in esculent mushrooms, which are cultivated beneath beds of straw.*

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* A striking instance of the influential agency of light on vegetation is, that plants, which receive the light of a lamp, are coloured green, as if they had enjoyed the light of the sun.

One of the most extensive elements in nature, next perhaps to gravitation, is the fluid matter of heat or caloric; in it all other bodies are immersed, and are preserved in their present state of solidity or fluidity by the different attraction of their particles to this matter; thus contracting the powers of gravitation, and of chemical affinity, which would otherwise compress all those particles into one solid chaotic mass. On the other hand, this elastic matter of heat is itself liable to become consolidated in its combinations with some bodies, when it is termed *latent* heat. This combined heat is universally set at liberty in the production of acids, by the union of oxygen with all inflammable bodies; and it is also taken from some bodies, by the vicinity of very cold ones, as water when frozen, loses suddenly a part of its combined heat, at the moment it becomes ice.

It is obvious, that without fluidity, the juices cannot circulate in the vessels of vegetables; and it is no less obvious, that the circulation of their fluids may be prevented, by too great a deduction of heat, whereupon the irritability of their fibres becomes palsied. The necessity of a certain quantity of caloric, to produce, or to preserve, the activity of the vessels in plants, is well evinced by experiments on the rising sap in vines, and the bleeding of the sugar-maple, which are repressed by cold, and advanced by heat,*

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* The influence of the weather, in varying the discharge of the sap of the sugar-tree, is so remarkable, that Dr. Rush is disposed to believe, there is some foundation for the opinion of Dr. Tongue, who

Hence we learn, that one of the principal properties of heat, in respect to vegetebles, consists in its acting as a stimulus; and that in this way it increases the activity of the system of the plant in the several functions of absorption, circulation, and secretion, consequently in the vigour of its growth.*

The existence and continual agency of the electric fluid in the atmosphere, has been ascertained by numerous, clear, and decisive experiments; and there is abundant reason to believe that this active fluid cannot exist in the atmosphere, without exerting a certain influence on all organized beings on our globe, whether they be of the animal or vegetable class. This principle is every where, and is always present, though latent and unobserved; it is likewise in motion by night and day, to maintain an equilibrium that is constantly varying. Atmospherical electricity, simply considered, is strictly spontaneous, as is proved by the production of electricity without friction.

Heat and water are conductors of electricity; and their being always combined in vapour, must increase their capacity for retaining their electron; so that water, in its rarefied state, requires, and will absorb more of the electric fluid than when in its

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supposes that changes in the weather of every kind, might be as readily ascertained by discharges of the sap from trees, as by the barometer.

* Darwin's Phytologia, Sect. XII. XIII.

dense state as water. The vapour also, by rising into cooler air, will be gradually condensed more and more, which must necessarily increase the intensity of its positive charge, and in whatever direction it moves, it is sure to move with a very energetic and expansive force.

The intensity of atmospheric electricity is augmented by cold; which is easily discerned in foggy weather. This increase of electricity by cold, and the contrary is a general law, and takes place in almost all the atmospherical phenomena. So that there is an increasing progression from the smallest signs of electricity, usually observed in warm small rain, to rain in large drops, and thence to snow and hail; for hail showers, of all others, are the most intensely electrified. There are, however, several other circumstances which conspire in the production of these effects, such perhaps as the height whence the meteors descend, &c.

In foggy or thick weather, without clouds, if the air be at the same time sharp or frosty, the electricity of the atmosphere is generally vigorous, and the intensity of its charge is usually sudden; but fog, accompanied with warm air, and going to resolve into small rain, or clearing expeditiously, is sure not to afford any, or but very weak signs of electricity. In Ireland, the air is found to be electrified even in a mist, both day and night, but principally in the winter season.

Dew contains electricity; which seems to depend on the quantity of the dew; and, in its various changes, appears to follow proportions similar to those which take place between the electricity of calm mild rain, and that of rainy and stormy weather, varying also according to the seasons.

From air itself not the smallest particle of electric matter ever comes; for there is reason to think, that air, independent of the substances with which it is impregnated, is unable to furnish an atom of this matter; and it is conjectured that pure air and electricity are actually incapable of uniting. Hence air is never known to attract, absorb, or conduct electricity, but in proportion to the conducting substances with which it happens occasionally to be mixed. Nor is air excitable to the emission of electric phenomena, by any means yet known; therefore air appears not to be either an electric or a conducting body.

In consequence of these peculiar properties of air, it is found to insulate the electric fluid more perfectly than any other substance, even when it is in that state of purity which is common to it in dry serene weather. Had not air possessed these properties, the existence of electricity could never have been discovered. Hence it is also manifest, that the phenomena of lightning and thunder, could not have occurred amongst the operations of nature.

Lightning appears to be spontaneous electricity in the highest degree. And whether we contemplate the matter of lightning as it respects atmospheric or artificial electricity, the substance is precisely the same: in both cases, the fluid is retained, and its effects transmitted by the same mediums; than which there is not, perhaps, a surer criterion whereby to determine the identity of this subtile matter, that is, electron naturally and artificially displayed.

From the observations which have been made on the electricity of the atmosphere, it appears, that Nature makes great use of this fluid in promoting vegetation. In the spring, when plants begin to grow, temporary electrical clouds collect, and pour forth electric rain. The electricity of the clouds and the of rain continues to increase till that part of the autumn in which the last fruits are gathered. The electric fluid is the agent which collects the vapours, forms the clouds, and is then employed to dissipate them into rain. These clouds, by extending their electric atmosphere to the plants, dispose their vessels to receive with greater facility the water which is impregnated with this penetrating and vivifying fluid. Hence may be explained the proverb, "*No watering gives the country so* "*smiling a look as rain.*"

This superior effect of rain, over river, spring, and other waters, may be explained by observing, that, as electricity is found to decompose water into two elastic fluids, viz. oxygen and hydrogen gas, it may aid the vessels of vegetables in this decomposition and preparation of the latter gas, which contributes to the nutrition of the plant, and to the production of its oils, resins,* &c. Or, is this vegetative efficacy of rain due in part to its being strongly charged with oxygen? Hassenfraz has shewn that rain and snow water contain a redundancy of oxygen, compared with river water, which they may have acquired in their descent through the atmosphere; and as oxygen promotes vegetation, this may possibly be another cause for the advantage possessed by rain in this process.

Additional proof of the utility of electron in the vegetable economy, is furnished by experiments made on vegetation with artificial electricity. These have been made principally with the accumulation of the vitreous or *positive* electricity, and but little with the resinous or *negative* denomination. Although Mr. Ingenhouz did not succeed in his experiments, the influence of the former description in forwarding the germination and growth of plants, seems to be pretty well established. From a few trials it appears, that the resinous electricity causes a quicker germination in some seeds than is caused by the vitreous.†

Another

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* Dr. Wollaston has lately, (1801) shewn by experiment, that water may be decomposed by common electricity, although no discernible sparks are produced.

† With respect to the terms *vitreous* and *resineus*, it may be remarked, that Du Fay and Muschenbroeck supposed that there exist two kinds of electricity; but neither they nor any of their followers gave consistent explanations of the laws by which those powers were governed. The true knowledge of those laws was a discovery

reserved

Another power, namely, *Galvanism*, may perhaps be found applicable to the fartherance of vegetation, especially considering its similitude to electricity. This is shewn by a striking resemblance which appears between the action of the galvanic pile, and that of a common electrical machine, viz. that they both seem to depend upon *oxydation;* so that the electric powers of both increase with the increase of oxydation, and *vice versa.* All the differences discoverable in the effects of the pile, may be owing to its matter being less intense, but produced in much larger quantity; differences, however, which may render galvanism more elegible than electricity for animating the germination of old seeds, and quickening the progress of languid buds.*

The economy of vegetation is considerably influenced by *habits.* Thus, seed growing early in the spring, and the stems stretching soon to flower, and producing but a few flowers, is a habit acquired by their having been propagated in a dry, sandy, warm

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reserved for the ingenuity of our countryman, *Henry Eeles, Esq.* who, in 1757 and 1758, transmitted to the Royal Society, Letters containing experiments and deductions, by which they were traced and expounded. Other writers on the subject, as Symner, Priestley, Nollet, &c. held the doctrine of two electric powers, but they were either imperfect in their principles, or took the hint from Eeles, whose opinion is espoused by Darwin, in himself a phalanx of support.

* Adams on Electricity, page 259, 264, 275, 313. Read's Summary View of Spontaneous Electricity, Chap. I. II. III. Philosop. Trans. Part 2. 1801. Artic. XXII. Darwin's Phytologia, Sect. XIII.

warm soil. Another habit is acquired by seed having been propagated in a moist, stiff, cold soil, which occasions it to grow late, being long pushing up the stem, so that there is not time for it to ripen. Other habits are acquired from propagation in rich soils, poor soils, &c. When these, or other injurious habits are noticed, it will be useful to change the seed.*

To ascertain these habits is an object of the first importance in that very useful branch of practical botany, the *naturalization* of plants. Many hot-house plants, by inuring them to the open air, can be brought to bear our climate. Thus, observes the experienced Mr. Templeton, " the Camelia " Japonica, Thea Viridis, and Calycanthus Præ- " cox, which were formerly kept in the hot-house, " then in the green-house, are now sufficiently na- " turalized to grow in the open air, and are as little " injured with the cold of our winters, as either " the common or Portugal laurel." He further observes, that some plants, which apparently are not fitted to our climate, do yet outlive our winters; and that without a knowledge of their native stations, we sometimes suppose plants to be tender which really are hardy; nay even that plants, natives of Chili, are decorated with much larger and more brilliant flowers in the open air of our climate, than they are when confined in a house.†

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* Fordyce's Elem. Agricult. Part III. p. 84.

† Trans. R. I. A. Vol. VIII. page 122—4.

Having taken a circumscribed view of the principal circumstances which appear to favour the germination and growth of plants, it seems necessary to advert to the causes which retard or suppress those functions, on which, however, we shall be still more limited. Amongst these causes, we shall here only notice an undue proportion of *oxygen*, of *light*, of *heat*, and of *electricity*. From the preceding observations on the use of oxygen in vegetation, it will be easy to conceive the several ways in which plants may be hyperoxygenated, and consequently damaged; for oxygen being a powerful stimulus, a more than natural or usual increase of it will exhaust the spirit of vegetation. On the other hand, a defect of this stimulus must contribute to diminish the vigour of a plant, and if it do not languish and die, its growth will be either stunted or slender.

The effects of light also, from the substance of the same observations, may without difficulty be understood, whether in relation to its defect or its superabundance. We can understand why plants growing in the shade become white, and why their exposure to the solar light renders them green. At the same time it may be observed, that insufficiency of light prevents plants from generating their proper juices, except sugar and mucilage; and hinders the impregnation of the seeds. Independent of the chemical agency of light, here signified, it would seem, from Humboldt's experiments with lamp-light, that the excess of this fluid, acting as a stimulus, does harm to plants, especially when they begin to rise.

As to heat, we have already remarked, that one of its principal properties is to increase the activity of the vegetable system, to which it thus acts as a stimulus; and that in an undue proportion, the stimulus amounts to an excess; in which manner it eventually produces in the plant weakness and its consequences. Heat also increases the action of other stimuli, and of poisonous substances.

The abstraction of heat, or what is called *cold*, besides its opposition to the adequate fluidity of the vegetable juices, must be unfriendly to the animation of the solids, causing either local canker, or the death of the whole plant. But when the vegetable fluids are chilled and converted into ice, their bulk is vastly enlarged, and this enlargement sometimes takes place, with such extreme violence, as to rend them in pieces. In this way, frost destroys those parts of vegetables, which are most succulent; particularly in that form called hoar-frost or rime, so common in the spring season. This species of frost is then frequently destructive to the early shoots of the *ash*, and to the early blossoms of many fruit-trees, as apples, pears, and apricots; which, being either more succulent, or having greater sensibility, are more liable to be injured by cold.*

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* The ash is a species of that genus of tree, whose sap contains the delicate saccharine matter called manua; hence its early shoots, impregnated with unoxygenous succulence, (for oxygen is the chief principle of sugar), are rendered liable to the physical effects of frost, whilst the quantity of their juices exposes them to its mechanical effects.

With regard to electricity, it is thought by Dr. Darwin, that plants are blasted by lightning, more frequently than is suspected. This he reckons demonstrated, by the shivers found in several trees, in cutting down extensive woods, and the injury done to the foliage of fruit-trees by lightning in England. On this point, he quotes Mr. Tull, who ascribes to lightning, both a hurtful and deleterious effect; which may be seen by the blackish parts or patches visible in a field of wheat, especially in those years, which have more thunder-storms than usual. Dr. Darwin believes that this evil occurs more frequently on damp situations than on dry ones; but it seems that against it, even the experienced Mr. Tull, cannot propose any remedy.

One of the modes in which lightning destroys or impairs the life of vegetables, Dr. Darwin thinks similar to that in which it affects animal life; which he believes, is, by its great stimulus, exhausting the sensorial power, in the violent action it occasions, and thus producing more or less unsusceptibility to the common stimuli, which ought to excite the vital action of the system.

Lightning may likewise affect vegetables in a way analogous to that which probably also happens, when their young succulent shoots are frozen, namely, by its expansive power bursting their vessels, as it passes through them. By this power are rent large branches of trees, stone buildings, and other bad conductors of electricity, when they are struck with lightning.

It seems necessary to mention a sort of lightning, which is seen in this climate, in a summer's evening, playing among the clouds. This kind of lightning generally happens in warm, serene weather, is never attended with thunder, and seems quite harmless. These circumstances plainly show, that some cause or condition is wanting, to produce mischievous consequences; that cause or condition, there is no reason to believe, chiefly consists in the distance of the phenomena from the earth, which is too great for the electrical atmospheres of such clouds, to disturb the terrestrial electricity. Probably, indeed, it is nothing else than the concourse of two or more, oppositely electrified clouds, darting their charges into each other.

In cases where the direction of this species of lightning could be traced, it was generally observed to be horizontal, or nearly so; except when it was evidently drawn aside by the adjacent clouds, which seems to indicate that it had but little, if any, communication with the earth; consequently it could not, by any striking force, injure plants.*

Of the internal diseases of plants, we need only, in this place, mention two, namely, mildew, *(crysiphe)* and rust *(rubigo)*. *Mildew* is a white mucor or mould, with dwarfish, tawny heads sprinkling the leaves. It is a plant of the fungous tribe, which, like other funguses, will grow without light, or change of air, and will, with its roots, penetrate the vessels of the vegetables that it adheres to. The foundation is laid in a previous disease of the plant, and is directly caused by the greater dampness of the land, and in its being too much overshadowed with thick foliage.

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* Fordyce's Elem. Agricult. Part III. page 84. Darwin's Phytologia, Sect. IV. Read's Summary View of spontaneous Electricity, Chap. V. p. 36.

Rubigo or *rust*, is a ferruginous powder, sprinkled under the leaves of the plant; especially in a burnt, woody soil. It is probably another fungus, similar to the mildew, or to some kinds of lichen, which grows beneath the leaves of vegetables previously diseased, and perhaps may be prevented or destroyed, by exposing the plant to more light, and greater ventilation, as in the mucor. Somewhat similar to this rubigo is a disease of plants, called *uredo frumenti*, or blight of wheat (literally a burning in corn). It is said to be a fungus, which covers the stems of wheat in wet seasons, when it is nearly ripe, so as to give the field an appearance of being covered with soot. The stem of the wheat appears to be split, and the growth of the plant to be much injured. Is this appearance in reality a fungus? Or is it a vegetable gangrene, arising from hyperoxygenation, or from diminished irritability in the plant.*

The analogy between plants and animals may be plainly discovered, by comparing the preceding circumstances, with the phenomena attending those animal functions, which are familiar to common observation; a comparison, however, which would be too long for the limits of this essay, but which may be found detailed in a clear and satisfactory manner, in Darwin's Phytologia. Here it is unnecessary to do more, than briefly state some facts, which may serve at once to illustrate that curious phenomenon, the moving power of plants, and the resemblance between the other laws of the animal and vegetable economy.

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* Darwin's Phytologia, Sect. XIV.

The moving powers of the sensitive plant (*mimosæ*) have been for some time known. That specise called *viva* or sensitive weed, is the most irritable of the family; so much so, that by running a stick over it, a person may write his name, and it will remain visible during ten minutes. The *plena*, however, is not only sensible to the touch, but to the influence of the air. The wonderful plant of *Sombrero*, thus named from one of the Nicobar islands, is a curious individual of the sensitive tribe, growing in the East-Indies, in sandy bays and in shallow water. It appears like a slender straight stick; but when you attempt to touch it, immediately it withdraws into the sand. The Malays term it *lalan lout*, that is, sea-grass.

Associated with the honey-suckle is that remarkable plant, named *hedysarum gyrans*, or sensitive hedysarum, a native also of the East Indies, where it is called *burrum chundalli.* It arrives at the height of four feet, and in autumn produces bunches of yellow flowers. It is a trifolious plant; the lateral leaves are smaller than those at the end, and throughout the day, are in constant motion, without any external impulse, moving up and down, and circularly, with unequal celerity. The circular motion is performed by the footstalks; and while the one leaf is rising, its associate is generally descending, which motions are observable, during the space of twenty-four hours, even in the leaves of a branch lopped off the shrub, if the branch be kept in water.

The *polypus*, a fresh water insect, is a curious animal, which may be propagated by slips like a plant. Linnæus gave it the name *hydra*, on account of the property it has of reproducing itself. If this insect be cut in twain, it puts forth from the upper part a tail, and from the lower end a head, so as to become, in a short time, two animals instead of one. If it be cut into three parts, the middle division also puts forth from one end a head, and from the other a tail, so as to become three distinct animals, all living like the first; and performing the various functions of their species. Nay, if cut into five or six pieces, there will be as many animals as pieces, exactly similar to their parent; and so great is this prolific power, that a new animal will be produced even from a small portion of the skin of the old one. Dr. Hill, therefore, justly gave this animal the appellation, *biota*, by reason of this strong principle of vitality, with which it is endued. The spontaneous propagation of this animal is, the emission of young ones from all parts of its body, or that of eggs from the same parts in autumn.

There also is a marine polype, which, though differing in form with the fresh water sort, is nourished, increases, and may be propagated in the same manner. From these phenomona, no wonder the naturalists, who first discovered them, were astonished at their properties, could hardly believe their own eyes, and were some time before they could ascertain whether they in right belonged to the vegetable or animal kingdom.

There is another organized being which, in zoology, has got the name of *animal-flower*, and that has likewise an extraordinary faculty of reproduction. It is also entitled *urtica marina* or sea-nettle, from its supposed property of stinging; and *sea-anemone* from its claws or tentacles being disposed in regular circles, and tinged with a variety of bright lively colours, resembling the petals of some of our most beautiful flowers. The shape and substance of these animals differ; but all of them are capable of altering their figure, when they extend their bodies and claws in search of food. They are found along many of the rocky coasts of the West-Indies, and likewise on some parts of the coast of England. So extraordinary, indeed, is their power of reproduction, that nothing more is necessary to generate as many sea-anemonies as a person wishes, than to cut a single one into the desired number of sections. At the same time, these animals have so much sensibility and instinct, that if an attempt be made, to pluck one of them from the rock to which it adheres, it cannot be effected with the fingers; for as soon as the fingers approach within two or three inches of the animal, it immediately contracts, and shrinks into the hole of the rock.

Microscopic animals are so extremely minute, as not to be discernible by the naked eye, and appear so different from larger animals, that one would be almost tempted to think, that they lived in consequence of laws directly opposite to those which preserve ourselves, and other visible creatures in existence. They have, however, the discriminating characters of belonging to the animal world, and accordingly have been systematically arranged into classes. Some have not any, and some have, external organs. Of the former class, the *monas* is the most numerous; this species consists of a mere point; and is found in various kinds of matter, in fresh water, salt water, stagnant water, urine, &c. and myriads are discovered in a single drop of these fluids.

Some of these animalcules multiply their species, by dividing themselves; and round others are perceived beautiful irradiations, whose use is not yet ascertained. Their motions are very interesting. A species of the *volvox*, termed *globator*, moves in every direction, backwards, forwards, up or down, rolling over and over like a bowl, spinning horizontally like a top, or gliding along smoothly without any turnings; sometimes its motions are very slow, at other times very swift; and when it pleases, it can turn very nimbly round, as upon an axis, without moving out of its place.

From the most correct observations on these and on all other animalcules, it appears that their motions are not purely mechanical, but are produced by an internal spontaneous principle; and that they must consequently be placed among the class of living animals, for they possess the strongest marks and the most decided characters of animation: it therefore follows, that there is no foundation for the supposition of a chaotic and neutral kingdom in organized nature; an idea which can only have derived its origin from a very transient and superficial view of these animalcules.

These few facts, compared with the preceding observations on plants, will furnish us with a clew to conduct us in tracing a resemblance between the structure and economy of animal and vegetable beings. Thus we perceive, that vegetables are viviparous and oviparous, that they inherit a species of sensation, that they have a circulation of vital juice, that they have secretory and excretory vessels, that they have organs of respiration, &c. and that in these respects they bear a similitude to animals. This analogy, indeed, has been traced in every phenomenon, except that of respiration, in which process, until very lately, it was not discovered; not even by the ingenuity and research of the learned Dr. Darwin. Humboldt has proved by accurate experiments made with lime water, and nitrous gas, that the crocodile, instead of diminishing the volume of the air like other animals, does on the contrary augment it. A crocodile shut up in 1000 parts of atmospheric air, containing 274 of oxygen gas, 15 of carbonic acid, and 711 of azote, increases this mass in an hour and forty-three minutes with 1124 parts; and these 1124 parts then contain 106,8 of oxygen, 79 of carbonic acid, and 938,2 of azote, mixed with other gaseous substances not known. Thus, in an hour and three quarters, the crocodile produces 64 parts of carbonic acid, and absorbs 167,2 of oxygen; but as 46 parts are found in the 64 of carbonic acid, the animal appropriates only 121 parts of oxygen, which is very little, considering the colour of his blood. He produces 227 parts of azote, or other gaseous substances, upon which acidifiable bases have no effect. This animal is so sensibly affected by carbonic acid gas, and his own exhalations, that he dies when placed in air corrupted by one of his own species; he, however, lives two or three hours without breathing at all*.

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* In contemplating this discovery of Humboldt, we should not forget, that the emission of oxygen by vegetables in the light, is not without exception, as already observed in the case of mushrooms, which, according to the same philosopher, exhale mephitic gas both day and night; an observation which may be brought to strengthen the features of resemblance between the vegetable and animal economy.—See Humboldt's Letter to his Brother, dated at Lima, November 25th, 1803. Encyclop. Britan. Artic. *Minosa*, *Sombrero*, *Hedysarum*, *Animal-flower*, *Polypus*, and *Microscope*.

SECT. III.

———" The circling sky,
" The wide enlivening air is full of fate."
THOMSON.

REFLECTING on the properties of the several substances which compose, or have a considerable agency in the atmosphere, that great and magnificent *apparatus* in the immense *laboratory* of nature, we must own that it is a scene of wonders, and be convinced that it is largely instrumental in carrying on the most important purposes of terrestrial creation. By its operations are produced the terrible, as well as the cheering phenomena of the natural world. Yet the most formidable phenomenon must have its use in the vast mechanism of this system, to preserve the balance in the several powers, and to co-operate with that of the mildest description in sustaining the grand and vivifying agency of the *whole*.

The sublime science of astronomy has been applied to illustrate the conditions of the atmosphere, and its effects on the economy of vegetation. Near 90 years ago De La Hire observed, that some persons imagined that the greater or less heat, which glows in the same season, in different years, may arise from the comparative number of spots perceived at the same time in the sun; and so that planet, in their opinion, when spotted does not throw forth so great a number of rays to the earth, that the heats must consequently be in a smaller degree than when it has no spots.

On the contrary, Dr. Herschel, who considers the sun a most magnificent habitable world, thinks that the spots, which he denominates *openings*, are symptoms of the copious emission of light and heat.* The difference of our seasons, with their consequences on vegetation, he ascribes to a greater or smaller emission of the solar beams; and he thinks that we may ascertain the goodness or badness of years by thermometrical observations, an abundance of the vivifying principles of light and heat taking place in good seasons, and in bad seasons the contrary. He also thinks, that there is an appearance of a change of seasons in our favour; and that by observing the *indications* of the sun for emitting light and heat, we may be able to *predict* the temperature of approaching seasons.

But the year 1802 was not favourable to this doctrine, and it is more agreeable to modern observation, to ascribe a great share of atmospherical heat, and its effects on vegetation, to a combination of other circumstances taking place nearer to the earth. De La Hire, indeed, adduces two instances, viz. in the years 1718 and 1719, wherein there were many solar spots and considerable heat in the air, which support Dr. Herschel's theory, as to the greater emission of empyreal gas, when these phenomena take place. Yet De La Hire does not agree with those, who supposed the temperature of the seasons, due to influences arising from these solar appearances; he rather thinks the variations of temperature, owing to the different exhalations from the earth, sometimes colder, sometimes hotter, and to the diversity of winds which rule in the same seasons, not having, so far as he knew, any regular periods in our climate.*

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* Lalande thinks that the sun is a solid body, but that his surface and part of his mass are composed of an incandescent fluid. This fluid, by a certain movement, leaves uncovered a portion of the body of the sun or his mountains, and these uncovered parts are the *spots*. Wilson looks upon the spots as eruptions or volcanos.

Other planetary influences should not escape our notice; particularly that of the *harvest moon*, which is said to have an effect in ripening and hardening grain. The sol-lunar influence, not only on tides, but on the periodical disorders of the human race, is an object at once curious and useful, and should, with the question relative to the solar spots, be put to the test of extended observation and experiment.

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* Memoires de l'Academ. Roy. de Scien. 1718. 1719. Philosoph. Trans. Part II. 1800. Art. XIII. XIV. Part II. 1801. Art. XIII. Mrs. Guthrie, in her tour through the Taurida or Crimea, lately published, gives a striking instance of curious varieties in climate and soil, occasioned by *local or terrestrial causes*; which she, at the same time remarks, ought to teach geographers not to judge of climate merely from latitude and longitude.

With respect to health and disease, the most important concerns in human life, it is universally acknowledged that the state of the air, and the temper of climate, have an imperious power in ruling these conditions of the human body. Nevertheless the several qualities of the atmosphere, which, in each known country, have such authority, are not yet sufficiently understood. To trace the nature of fever, pestilence, and contagion; to investigate the causes of epidemical distempers, the labours of a medical meteorologist may be usefully directed: this is a walk of an extensive range, a walk unquestionably full of objects interesting to society.

A variety of common arts, the art of bleaching for example, may be improved by an extension of the doctrines which develop the phenomena of the atmosphere; such as the operation of light, heat, and moisture, separately and in combination, on vegetable substances in the process of manufacture.

A branch of geological science, the discovery of mines, which partly depends on the state of the air, in which the analysis of mineral waters is carried on, may be facilitated by meteoric knowledge. It will also assist geological inquirers, in tracing the various causes, to whose activity the earth owes its present wonderfully diversified appearance, such as the general deluge, particular inundations, earthquakes, volcanos, &c.

Meteoric observations may be applied to the detection of springs, which in some cases cannot be discovered by the common geological knowledge of the various strata of the earth. For instance, the appearance of mists about mountains and moist places, at certain periods of the day; and the comparative solution of hoar frost in particular spots of a precinct, where it is essential to find out the source of springs. This art is of importance to the cultivator, both for the purpose of draining those lands, which too much abound with water, and for the purpose of watering those which are too dry, and that lie beneath the level of the springs, or whereunto water may be raised by machinery. Not only in this respect, but in various other cases of moment, such as regulating the time of sowing, entering on hay harvest, &c. might the husbandman acquire assistance from the doctrines of meteorology.

It is true, indeed, that, in order to produce a satisfactory system of meteorology, the inquirer ought to possess materials and documents, which no individual, perhaps no community, has hitherto attempted to collect, and which we can scarcely expect to obtain in the present mechanism of society. But, admitting all difficulties and defects, until the existing state of knowledge shall be greatly advanced, it is certainly in our power to gather histories, to accumulate observations, to methodise them, and to approximate nearer and nearer to a system, as perfect as the limited faculties of man can accomplish.

The ingenious Dr. Waterhouse declares, it has always impressed him with something bordering on wonder, that, during *six and twenty centuries*,* wherein the memory and learning of mankind have been exercised, there has not been found ONE SECRETARY OF NATURE sufficiently instructed to give us a complete history of the various meteoric phenomena, with an entire and connected chain of causes.

Notwithstanding the confessed difficulty of this pursuit, the Doctor observes, "although much of "the operations going forward in the atmosphere, "may have some links that have hitherto escaped "the most inquisitive eye, and others, though seen, "may not be fully understood, still we ought not "to be discouraged. These detached links will "one day be united, and form a part of the great "chain of natural causes, adding still stronger proofs "of that *unity of design* which pervades the great "*Temple of Nature.*" He is even of opinion, that some future Franklin may do with the accumulated facts in meteorology, what Newton did with those collected by Kepler and Galileo, and therewith form a system which may teach man to bridle the *winds* themselves, and render them farther subservient to human uses.†

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* Perhaps Dr. Waterhouse, who is professor at Cambridge, Massachusetts, should have said, during more than *thirty-three centuries*, reckoning from the birth of Moses to the year 1803 of the Christian æra.

New York Repository, Vol. V. page 469, 472.

Though still far from this attainment, ingenious individuals have done much, and may do more; but considering that the materials in this sublime department in nature, lie in detached and scattered pieces, hardly will any *individual* undertake the labour and expence, or can have the opportunity, without *public support*, to collect them, and give them the advantages of a systematic form. Copernicus, Boyle, Locke, Newton, and other ingenious men, did much in promoting physical and moral instruction; yet their works did not supersede the necessity for public establishments, to advance those very branches of knowledge, in which their exertions were prominent. Nay, perhaps, the curiosity which they raised, and the light which they shed on the subjects of their research, conspired to render those subjects, at once increased objects of public attention and patronage.

"When," says an excellent judge in those matters, "the vast importance of meteorological knowledge "to agriculture and navigation is considered, there "is at present, some room to hope that *establishments* "of this nature may take place, at *no very distant* "*period*. The number of persons, who, from a view "of attaining a settlement in such establishments, "would receive an education in the different sciences "connected with meteorology, (that is, indeed, all "the different branches of mathematics and natural "knowledge), and the emulation, thus excited, "would necessarily diffuse a considerable mass of "knowledge throughout the community." As examples for us to follow, the same distinguished labourer in this field observes, that Theodore, the late Elector Palatine of the Rhine, realized this project in his dominions; and that Catharine, Empress of Russia, conceived a similar design, shortly before her decease.*

I have elsewhere observed, that Ireland is naturally adapted, for an institution of the kind here proposed. It is placed in a situation strikingly central between the *old* and the *new* world; its temperature, as to heat and cold, is remarkably moderate; the highest part of its *general* surface is not more than 270 feet above the sea; and its loftiest mountains are low, compared with the elevation of those, in the regions east and west of it. These natural circumstances are so manifest and advantageous, that it were a pity that art, which is no more than the handmaid of nature, should not do its duty, and through negligence, leave incomplete what its mistress had kindly pointed out for the benefit of the servant.†

The most appropriate name for this foundation, seems to be, "*Institutes of Physical and Moral Geography;*" for which should be appointed a professor, whose duty it would be to give public lectures, comprising as much of the ancient character of all countries, as could be ascertained, together with the present circumstances of every known region, as to climate, diseases, customs, products. A knowledge,

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rwan, Trans. R. I. A. Vol. VIII. Science, p. 277.

† Trans. R. I. A, Vol. VIII. Science, page 264, 5.

knowledge, not a bare, but a competent knowledge, of these subjects, inasmuch as they minister to the advance of science, and the culture of the liberal and useful arts, is important to the interests of any community; and in a tenfold degree, is it essential to those of the united kingdom of Great Britain and Ireland, which, together with valuable sciences and arts, fine lands, &c. within itself, hath possessions or commerce in every frequented country on the globe.

Not only would these lectures be desirable in a physical, moral, and political sense, but they would be advantageous, in a classical point of view. The investigations into ancient history, which such a course would necessarily require, would call forth observations on the characters of remote ages, compared with modern times, which would have a useful effect on the intellect of youth, and render growing generations, as far as its influence could extend, not merely dupes to sordid pedantry, and scholars solely in *dead* languages.

Whilst an institution of this description would eventually be of general service, it would, in a direct manner be locally advantageous to the metropolis, where it would, of course, be founded. There, with the several other establishments already made for the improvement of the sciences and the arts, it would combine in forming a *circle of literary schools*, wherein would be cultivated and taught, every object of useful pursuit. This additional course of lectures, instead of trenching on any of those at present established,

lished, would have a tendency favourable to them all. Being in a great measure elementary, forming a series of connecting links in the immense chain of nature and art, it would attract the student to the temple of science; it would unfold to him the doors of that glorious edifice; it would hail his entrance; it would methodise his conduct in the state of pupilage; and it would open to his view several chambers containing the rich furniture of wisdom and virtue.*

For communicating such information, which evidently touches on many branches of human knowledge, lectures are extremely well calculated, and have long been held in high estimation. In order to succeed, a lecturer must come before his audience well prepared, to present to them the harvest of his labours, which he does, in *living language*; in living language, whose signal power of making a strong and lasting impression on the human mind is felt and acknowledged by all. A written discourse, compared with one delivered *viva voce*, differs from it as much as the *dead* does from the *quick*; the shape and members of the former may be all entire, but, lacking *the spirit of animation*, it may be resembled to a species of *caput mortuum*.

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* There is not an insulated fact in nature; all things have a mutual connection or dependency more or less direct; and in our world, (most reasonably too throughout creation) the great circular chain, which links entity to entity, does not want a single ring, though human knowledge be not yet arrived at that pitch of perfection, competent to trace with precision every point of union. Already we have seen, that the phosphat of lime, which was supposed to be confined to the composition of animal bone, is now found to be an ingredient in the vegetable system; and sugar, which, for a long time, was thought to exist only in the sugar cane, is now known to be present, not only in several other species of the vegetable, but even in some of those of the mineral kingdom. Vanquelin has discovered the saccharine substance in the emerald; and he also found that the beryl or aigne marine, is composed of the same principles as the emerald, the colouring matter excepted, which is the oxyd of chrome. The animal kingdom, likewise, produces saccharine juices; for example, some of the products of milk yield a matter of this kind; and the actions of the human vessels are, in certain cases, so modified, as to generate in the urinary secretion, a saccharine substance, which is susceptible of the acetous and spirituous fermentation.

Exclusive of its advantages to a country, the foundation of a public establishment for the cultivation of science, gives dignity and splendour to the state; and at the same time, it may be accomplished by a small comparative expenditure. Men of science are seldom avaricious. Devoted to the study of nature, they have ordinarily but few acquired or artificial wants, and consequently they are contented with a moderate provision. A salary which would appear trifling and indequate to the support of a luxurious person in fashionable life, in a great city, is amply sufficient for the maintenance of the labourer, in any walk of natural history, who dedicates himself to the study, the laboratory, the field, the forest, or the mountain. The whole establishment of such a man would not require, for twenty or thirty years, more than an ambassador, or an envoy extraordinary, would consume in one; whilst the good that might ensue to the nation, would be an inverse ratio to the expense.

A person who undertakes the task here proposed, that is, the culture of an *infant science*, must in several particulars commence with being a *scholar;* of which, indeed, he need not be ashamed. The candid avowal of a scarcity of materials, with the difficulties thence resulting in the commencement, would rather redound to his credit. The less he knows at the outset, and the more he feels the necessity of acquiring information, the more reason there is to hope, that he will by exertion, attain to the degree of capability at which he aims.

He who thus, as it were, creates himself, and creates the science which he is to teach, who labours not only for himself and his cotemporaries, but also for posterity, has prospects too animating to be dismayed, by even considerable difficulties, from embarking in the design. It is, in fact, almost always in the power of every man to accomplish more than he conceives, to perform more than he undertakes; and therefore it is both wise and praise-worthy to attempt every thing that is morally within our reach. Many dormant ideas may be awakened by mental exertion; and the intellect exercised in this manner, will produce a variety of sound sentiments, which otherwise might have lain in eternal sleep.

SECT. IV.

IT is unnecessary to employ any formal arguments to shew what may be readily comprehended, by any one of moderate reflection, namely, that it is at once beneficial and practicable to diminish the quantity of imports for manufacture and home consumption, by introducing or extending the culture of various articles of native produce, which, in these islands, we are now content to derive from abroad. With this view, we should act on the fundamental principle, "*That the labours of the plough fill the* "*sail; and drive the shuttle;*" from which it follows, that agriculture is the basis on which to found the security of the state, and the prosperity of the people.

We should not suffer ourselves to be deluded by the *golden dreams* of commerce, that is, commerce in the extreme, or a foreign commercial system, which, instead of being subservient to our domestic industry, cripples it and keeps it in chains. At the same time, it is certain that our naval power, upon which our existence as an independent people essentially depends, cannot be maintained without a large measure of commercial intercouse with other nations. Neither can the state, without such intercourse, preserve its necessary relations with foreign powers, nor acquire a considerable portion of its indispensable revenues, by any other modus at once so productive, and so long sanctioned by experience. The evil, then, to be avoided, is giving to foreign commerce too great a dominion over domestic labours in agriculture, arts, and manufactures. All put into the balance of wisdom, each will have its due weight, and unquestionably *agriculture*, the first art of man, will ever preponderate.*

Among the works of agriculture, *planting* is entitled to the most sedulous attention. Of all vegetable productions trees and shrubs are the hardiest; they grow spontaneously where no other plants can thrive, and they surmount all others of the leafy race. With them nature covers even the most barren parts of the earth, provided her endeavours be not thwarted by man, or by other animals. Hence, in the progressive population of the globe, forests have been found to overspread almost every uninhabited region. Mankind could not penetrate any where, without meeting the valuable supplies of fruits, wood for fuel, and boughs and leaves to afford

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*———" To censure trade,
" Or hold her busy people in contempt,
" Let none presume. The dignity, and grace,
" And weal of human life, their fountains owe
" To seeming imperfections, to vain wants,
" Or real exigencies; passions swift
" Forerunning reason; strong contrarious bents,
" The steps of men dispersing wide abroad
" O'er realms and seas."

DYER.

ford shelter against the inclemencies of the weather. In Ireland there are few situations so bleak or barren, as not to disclose remains of a natural ligneous vegetation; and what nature has formerly done in this respect, may, by studying her ways, be reproduced by art.*

In England, though so very much superior to Ireland, in its ligneous coverings, they complain that the internal supply of timber is not at all in proportion to the consumption. They have, indeed, some remains of the old forests; in numerous parts they have hedge-rows of trees and hedges of underwood; and there are clumps and plantations of wood in all those modes of distribution in which trees and shrubs can be used, to make, as it were, the shading and colouring of the landscape. The kitchen garden of the farmers and cottagers too, are here and there surrounded by hedge-rows of trees; but the cottages lately erected, rarely have those rows around their little spots of garden ground, and the ancient trees ornamenting their church yards, are rapidly cutting down, without their places being supplied with a young growth.

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* "Principio arboribus varia est natura creandis;
"Namque aliæ, nullis hominum cogentibus, ipsæ
"Sponte sua veniunt, camposque et flumina late
"Curva tenent."

Virg. Geor. Lib. II. v. 9, 12.

"At first, by various ways, o'er hill and plain,
"Spontaneous woods clothed Nature's wild domain:
"Some rise at will, and with uncultur'd shade
"Fringe the wild streams, and darken all the glade."

SOTHEBY.

In such of these instances as owe their trees to modern plantation, the choice of the species has been regulated more by the consideration of the rapidity of their growth, and the particular colouring of their foliage, than by a due regard to the utility and excellence of their timber. The annual cuttings of the whole are very small in comparison with the total quantity of timber which is yearly consumed, or otherwise put to use in that country; and the internal supply is growing every year smaller and smaller. At present, both Great Britain and Ireland suffer a considerable drain of money to pay for the timber which they receive from America, the North sea, and the Baltic. But these resources for the supply of foreign timber begin to be exhausted, and consequently the article will not only grow progressively more scarce, but the balance of trade will, in those countries, become proportionably heavier against us.

The eastern parts of the Anglo-American provinces are, here and there, so bare of trees, that the inhabitants, at any distance from the great rivers, already find wood to be an article of heavy expence. Throughout the whole of the United States, indeed, the timber is daily falling under the axe of the cultivator; and treatises are written, with the avowed design of prevailing on the people to clear and settle their wooded tracts with still greater expedition; for instance, one by Mr. Sibbald, on preparing for culture the pine-lands of Georgia.* That most invaluable tree, the *live-oak* of the southern states, is wastefully destroyed, and not protected as it ought to be, by the proprietors, the states, or the federation. The savannas (meadows), situated in the middle of the forests of the American continent, are burnt annually, by the savages, and by the new settlers, for the purpose of renewing the grass, attracting the deer, and pasturing cattle. These fires spread into the woods, and destroy the great trees, from the horizontal roots of which sprout oaks, but they are dwarfs, and consequently not fit for the uses of those fine large ones that were consumed.† Besides, the woods are inten-

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* Mr. Sibbald draws our attention to an exotic in Georgia, which he considers, from its form, to have been destined by nature for ship-timber; and that nothing would induce an idea to the contrary, but its quick growth. This tree is called the *Pride of India*, or vulgarly *China Tree.* Its figure, its foliage, and its flowers surpass in beauty all the trees of the forest. It makes handsome furniture, somewhat resembling the wood which is used in Cuba for ship-building, named Spanish cedar or Spanish mahogany. If the China-tree would answer the purposes of naval architecture, in ten years growth it would produce timber fit for vessels of 120 tons burthen. Ought not attempts to be made to naturalize these trees in our islands? Cedars grow well, on a limestone substratum, even in the North of Ireland; for instance, in the fine timbered grounds of G. L. Coningham, Esq. of Springhill, county of Derry, where the beauty and magnitude of those trees indicate a situation as genial to their nature as that of the ancient Libanus.

† Several travellers, not having had time to observe these oaks with sufficient care, have taken them to be a particular species; but those whose acorns have been planted, have sent forth, like all others, a descending root, without producing succours; whence it seems probable, that there are no scion-bearing or stoloniferous oaks. New York Reprository. Vol. V. page 441, 46. Id. Vol. VI. page 68, 70.

intentionally set fire to, in order to clear the lands more quickly and cheaply, than they could be by cutting down the trees.

In Norway and Russia, timber is much less easily obtained, than it was an hundred years ago; because the forests nearest to the harbours on the sea-coast, and to the great rivers, have been gradually cut down, for the convenience of exportation. In smoe parts of those northern countries, the scantiness of provisions obliges the inhabitants to bring as much of the surface under cultivation, as they can manage; and, for this purpose, they clear the woods, as done in North America, by setting fire to the trees, after which, the plough is introduced among the charred trunks, and the ground roughly scratched.

This is a practice, which may, in truth, be called an indiscreet passion for tillage, and is often in their case, as also in that of the Americans, productive of the worst consequences. The thin soil, loosened by the implements of culture, and pulverized by the summer heats, is soon swept away by the rains of autumn, and leaves the bare rock encumbered, sometimes with loose masses of granate. No trees spring up to cover the surface, for the scattered seeds can hardly take root; the tender shoots, now without shelter, cannot withstand the fury of the piercing winds; and thus are whole tracts condemned to perpetual sterility. If to this we add the increasing state of the Artic ice, which must render the climate of those northern countries still more rigorously cold, we must expect that a progressive and insuperable hostility to the growth of plants, will there be the natural result.*

From the primitive ages of any nation, little information is handed down to posterity with respect to planting, or to other arts of peace; and therefore, in regard to the ancient woods of Ireland, a country often and long in states of considerable intestine disturbance, we want documents whereon to found satisfactory intelligence; hence we can only offer an imperfect sketch from the best authorities we have met with on the subject. In the earliest times, Ireland, like other countries in Europe, was, no doubt covered with forests, and its inhabitants, for similar reasons, led the uncivilized life of hunters, herdsmen, and rovers. In this forest island they would have plenty of game, and other means of subsistence they would derive from the fertility of its pasturage, with the abundant stores of fish in its lakes, rivers, and seas. The destruction of the forests would follow from various causes: the natural progress of the aborigines in civilization; the accession of other people having more knowledge in the arts than themselves; those new-comers wishing to clear the land of woods for the sake of security and tillage; and other causes which need not be here enumerated.†

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* The same indiscreet passion for tillage is observed to take place in some parts of England; for example, in Essex, where immense quantities of timber have fallen before the axe and the mattock, to make way for corn. See Howlett on tithes, page 28.

† One of the ancient names of Ireland is said to have been *Inis-na-fiodhbhaidh*, i. e. woody island; but this name, applied to Ireland, ap-

Certain it is, that at a very early period of Irish history, there appears to have been a scarcity of timber in this island, if we may judge from the Brehon laws, which were particular and strict in clauses for its preservation. According to these laws, the timber or wood was divided into four classes: 1, *Airigh*; 2, *Athar*; 3, *Fogla*; 4, *Losa*. In the first are included oak, hazel, holly, yew, a species of pine, and apple; in the second are alder, willow, hawthorn, quickbeam, birch, and elm; in the third are black-thorn, elder, spindle-tree, white-hazel, and aspen; in the fourth are fern, furze, brier, heath, ivy, reeds, and thorn-bush. These latter sorts were set apart for fuel; which not only shews the precision of the legislative system, but the scarcity of peat-moss as well as of wood. Native rustics, however, were allowed to cut wild crab-trees and small branches of white hazel, for certain specified purposes; and they were permitted to burn brushwood in the night, to dress fish.

At the same time they were very careful of their fences, and provided laws against various kinds of trespasses on land, whether occasioned by neglect of herding, of confining, or of fettering beasts. The different species of animals are enumerated, and the penalties

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pears to be a mistake of our old historiographers, and probably was intended for one of the Ægean islands, supposed to have been formed by the Samothracian or Ogygian flood, which happened, according to Sir I. Newton, 1045 years before Christ. Vallancey's Vindication, page 14, 26.

penalties affixed to each, viz. cows, horses, and swine, together with sundry petted animals, as herns, deer, wolves, foxes, &c. People likewise were prohibited clambering over ditches, and swimming, or fording rivers, to go into lands. The fines for breaking ditches were regulated by the width of the breach, which was measured by the number of stakes, three, five, eight and twelve in breadth; and as the enclosure of the bawn was ordered to be topped with stakes interwoven with brambles, it is probable that *stake-and-race* hedges were then much used.

None but the royal carpenters were privileged to dwell in the woods, according to the seanachas, or old law; so that it appears there were public laws of a very remote antiquity in Ireland. A distinction, indeed, is noted between the laws enacted in the time of Paganism, and those established since Christianity. In the former or Pagan times, those laws respecting the preservation of wood and fences seem, from their station in the code, to have been enacted, especially as being entitled *seanachas* or the old law; whilst the latter, or Christian times were distinguished by another appellation, viz. *the beginning of peace*.*

The Indo-Scythian emigrants from Spain not only cut down the woods in Ireland, but the form of their government was hostile to improvements. After the demise of *Heremon*, scarcely did any come to the throne of Teamor, but through the blood of his immediate predecessor; and this lust for dominion, with all its consequent turbulence, the depravation of the Fileas, &c., notwithstanding the endeavours of some wise princes, kept the nation in such general commotion, throughout many centuries, that the peaceable arts of life could not advance. Hence rural improvement, such as *planting*, could not be supposed to flourish in those times; and the natural woods, if not intentionally cut down, would undergo the fate of neglected property. It is true the settlements of the Fileas, and of the Druids probably, wore a sylvan complexion, and were held long sacred; but this would be the case of both only in certain districts, whilst the latter, by their corruptions, became disrepectable, and the former dwindled to nothing after the introduction of christianity.[*]

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* Vallancey's Collect. page 72, 669.

Whatever plantations belonged to these Pagan settlements, it is likely, were preserved by the monks; and this island being, for some centuries afterward, the seat of learning, its best patron, tranquillity, would be favourable to the plantation of trees, as well as to other agricultural improvements. Nay, there are grounds to believe, that the labours of the monks, and the protection they afforded to plantations, gave a wooded character to this country, which it did not lose for several years. We have the authority of Cambrensis for stating, that, in the twelfth century, Ireland was covered with forests, which, in the English settlements, were gradually cleared to make room for agriculture; but in those parts possessed by the Irish, it appears that they remained with little diminution for some centuries.

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[*] O'Connor's Third Letter, Collect. Hibern. Vol. IV. page 107. In little more than 200 years after the first Milesian landing, besides what ground private exertion cleared of woods, no less than 62 large tracts of waste land were prepared for tillage, by the contribution heir princes. O Halloran's Introduction, Chap. III.

Tradition informs us, that Westminster-Hall, which was rebuilt in 1399, was roofed with the celebrated oak of *Shillelagh*; oak brought from the same woods is said to form the timbers which support the leads of the magnificent chapel of King's College, Cambridge, built in 1445, and the same source, we are told, supplied the timber for the roof of Henry the VIIIth's chapel, in Westminster, built before the middle of the sixteenth century. It is generally understood, that about the middle of the seventeenth century, a sale was made of the finest timber that remained in Shillelagh, and after that period the residue of standing timber underwent rapid destruction.*

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* Hayes on Planting, page 110, 111. Statistical Survey of Wicklow County, page 115. Mr. Hayes says that Shilelagh signifies Fairwood; but there may be another derivation of the term: the ancient Irish had a military corps called *Shililah*; they fought with spears made of oak, pointed and hardened in the fire, and were a kind of light armed irregulars. *Shileelah* is a common name, at this day, for a stick burned at the end, carried by the peasants as a weapon of defence. Collect. Hibern. Vol. IV. Preface, page 57.

Though timber was early sent hence to England, and though Cromwell did not spare our woods, they were not brought to a greatly reduced state, till about the year 1606, when they suffered great diminution for making charcoal, to be used in the iron-works then set up in different places. But what chiefly contributed to their almost total annihilation, was a very profitable trade carried on, during several years, in the exportion of pipe-staves and lumber.

From these causes, as Boate observed about 150 years ago, the country was so bare of woods, you might, in some parts, travel whole days without seeing any trees, except a few near gentlemen's houses. Beginning some miles south of Dublin, and travelling to Drogheda, Dundalk, Newry, and as far as Dromore, not a wood worth speaking of, was to be seen, and in some parts of this course, a single tree was not perceptible in many miles. As to the *great woods* which the maps represented upon the *mountains*, between Dundalk and Newry, they were then no more; not even a vestige of them remained, save one poor solitary tree near the high-way, at the top of one of the hills, which, being seen at a great distance, served as a guide to travellers.

Still, however, he tells us, several great woods then remained, both in Leinster and the other provinces. In Leinster, he instances the county of Wicklow, King's-county, and Queen's-county, which were throughout full of woods, some of them many miles in length and breadth; and parts of the counties of Wexford and Carlow likewise were well wooded.

In Ulster, there were great forests in the county of Donegall; in the north part of Tyrone; in the county of Fermanagh, along Lough Erne; in the county of Antrim; and in the northern district of the county of Down; besides several other smaller woods in other parts of the province. But the county of Louth, and far the greatest part of the counties of Down, Ardmagh, Monaghan, and Cavan were almost every where bare, not only of woods, but of all sorts of trees, even in places which, at the beginning of the century, the seventeenth, were encumbered with thick forests.

In Munster, although great havock had latterly been made of the woods, there were still sundry considerable forests standing in the counties of Kerry, Tipperary, and even in the county of Cork, where they suffered most. Besides these, there were many smaller woods scattered over the province.

Connaught was well stored with trees, but had very few forests or great woods, except in the counties of Mayo and Sligo.*

The destruction and consumption of those woods, by using them so much for fuel, was a great waste of a material conducive to fertility. By the process of combustion, the nutritious juices, which exist in the fire-wood, fire-wood, are decomposed into their elements; and the carbon, united with oxygen, is diffused in the atmosphere, and, in an island such as Ireland, will be partly carried by the winds into the surrounding ocean. Thus is the fertilizing property of the wood dissipated, instead of furnishing the manures occasioned by the slow decomposition of it upon or beneath the soil, or by the depredation of insects; which might supply less decomposed nutriment to the absorbent roots of plants. Hence in extensive countries, as America, and great cities, as Paris, where wood is the fuel, the districts that supply it must be greatly impoverished, not only through the necessity of using large tracts of land for the growth of fire-wood, but also because so small a part of it returns as manure.* It will also be shewn in the sequel how inimical the speedy and extensive consumption of woods or forests is to the principles of vegetation, as well with respect to a nutritive atmosphere, as to a productive soil.

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* Boate's Natural History of Ireland, Edit. by Grierson, 1726, Chap. XV.

So sweeping was the waste of timber, in some districts, that scarcely did there exist a sufficiency to favour the supposition that this island ever possessed a valuable growth. But from the best authority, that of Mr. Hayes; from the County Surveys already published; and from the number of advertisements daily offering for sale woods of considerable extent, in several places in Ireland, there is reason to conclude that, on an attentive and general inspection, we should find still standing a far greater number of large trees and respectable plantations, than a traveller could suppose, on a cursory view of the country.

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* Darwin's Phytologia, Sect. X.

But lamentable would be the condition of Ireland, were it true, as it has been roundly asserted, that "human industry cannot now rear a twig of "the hardiest tree," in those parts of the country where timber formerly flourished! if that position, with all its ramifications and deductions, were suffered to pass unexamined and unanswered, it could not fail being prejudicial to the country, inasmuch as it tends to nip the germ of industry, and to chill the ardour of improvement, without which, a nation cannot thrive, nor advance to its natural degree of consequence. We should, therefore, in a matter of such moment, remember with what facility an error may be planted in the public mind, and with how strong a grasp it holds the national faculties, especially when fostered by the influence of ingenuity and rank. Hence the leading object of these pages is to examine the arguments offered in favour of the above opinion, and to expose whatsoever appears fallacious, in a principle of such injurious agency on the public weal.

SECT. V.

“ But cheerful are the labours of the loom,
“ By health and ease accompany'd: they bring
“ Superior treasures speedier to the state,
“ Than those of deep Peruvian mines, where slaves
“ (Wretched requital) drink, with trembling hand,
“ Pale Palsy's baneful cup.”

DYER.

THAT powerful bodies of people, originally from Asia, arrived in Ireland many centuries ago, is a position now so clearly demonstrated, as to bear the test of critical examination, and to be manifest to every person who does not shut his eyes against the light of reason, history, and truth. The first colony, after making a settlement in Spain, was thence by Milesius led to this island, and reached it about 700 years before the christian æra; the last colony arrived in the time of Julius Cæsar, about the year 60; the former were the *Pheine*, the latter the *Hermini* of Irish history. Besides these appellations, the oriental colonists went under the several other names of *Aire-Coti*, *Sacæ*, *Phaili*, *Cuthi*, *Fir-bolg*, *Fir-D'Oman*, *Tuath-Dadan*, &c. Along with them, it is certain, they brought the language, the religion,

gion, the customs, the arts, and the forms of government peculiar to the eastern stocks from which they sprung, and with whom they mingled.*

Amongst the arts which they possessed, that of manufacturing linen cloth was none of the least important, and one in which there is reason to believe, they arrived at a tolerable degree of perfection. The Aire-Coti were famous for weaving linen, and for linen geer. The Irish for the manufacture is *Anaat*, *Anaet* or *Anart*, and *Indic*. The three first are of Arabian derivation; the last plainly shews, though an obsolete word, that they borrowed this art of an Indian people. The names, indeed, of the materials, machinery, &c. belonging to the art of making linen, are the same in the Gælic, Chaldee, Hebrew, and Arabic.†

The profession of making cloth was formerly much respected; and the *Tan-treabha*, the tribe or clan of weavers, had particular privileges. To this distinction they seem entitled, from the ingenuity and exactness necessary to excel in the art, as well as from its utility to the public. The manufacture depending on the exact number of threads; it is necessary that the threads of yarn should be counted when they would be reeled. For this purpose, the

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* Vallancey's Vindication and Prospectus, *passim.*

† The Aire-Coti possessed the art of manufacturing both woollen and linen-cloth; to the former, as they did to the latter, they gave also an Arabic name, *Fuaite.* Vallancey's Prospectus, Introduction p. 22, 23.

Irish early fixed a method, which is found expressed in their language, and which continues to this day. The housewife's reckoning with her reel thus went on: at every twenty she made a *scor* or notch on a stick, hence *score:* every ten score, makes a *cut* or *centus*, i. e. *centum;* and every twelve cuts make a *cion-mor* or *skean*, or, as we call it, a skein, hank, or dozen; which by law should contain exactly 3600 yards. The reel is named *Tasculac*, *Creisthocras* or *Cros-tocais*, the X or cross for reeling.

From the threads being numbered by scores, to form the required breadth of the cloth, the weaver, when he extends the warp or chain, at every score makes a *fighi*, that is, a knot wove round them; hence *fighed* to weave, to twist, and also the number twenty, written *fighed* or *fighean*.[*]

Lin is the Irish for both flax and cloth, and is the diminutive of the Arabic *liha*, the bark or fibres of a tree. *Faith* cloth, linen cloth; *faiths* expressly means linen cloth; *cnap-fas* the coarse tow of hemp or flax, or the knobby part of which sacken and winnowing-sheets are made. *Tobhlinta tolanta*, pronounced *holinta*, fine linen; hence *holland*, the English name for fine linen, from *tob* good and *linta* threads of lint. *Anur* and *anurt*, narrow coarse linen, made chiefly in Munster, for meal-bags and peasants shirts; it is also called *band-lamh*, and contractedly *bandal*, which signifies a cubit or length of the arm from the elbow downward. To cotton they gave the name of *maoigreann*, *maogcairce*, meaning both real and bastard cotton.*

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[*] On the reed, (arundo phragmites), provincially *empty-rot*, which grows common in our strong wet grounds, the weavers used to wind yarn in the shuttle

The Magogian Scythians, from whom the Irish originally sprung, were remarkable for the manufacture of *hempen* sails, when seated in Bethsan or Scythopolis, in Palestine, which was early distinguished for the manufacture of fine linen. It is probable that our primitive ancestors brought the art of manufacturing hempen cloth with them from thence, as the modern Omanites, their successors in the same country, continue to practise it, whilst it is not followed by the neighbouring nations. Hence we may form some conception why it was not early known to those ancient nations east of us, whom we have been accustomed to look upon as the patterns of the arts in Europe. Mongez, says the Greeks, knew the use of hemp as cordage and caulking vessels in the time of Aristophanes, that is, 200 years before Christ; but they did not then cultivate it; for Theophrastus, who died above 80 years before Aristophanes, takes no notice of this plant, and Hiero procured the tow of it from the northern countries of Europe. He also thinks it

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* *Canasb*, *cadus*, *caonur*, &c. were also names for cotton, Collect. Vol. III. p. 555. 52. Collectanea de Reb. Hibern. No. XII. p. 477, 554, 560. Id. Vol. III. p. 477, 555—56—57. Vallancey's Prospectus, Preface, p. 8, 14, 21. Id. Introduction, p. 22—3.

most likely, that the Greeks only began the culture of it toward the commencement of the vulgar æra. The Romans, as well as the Greeks, made use of it for cordage and caulking, but it does not appear that either the one or the other made it into cloth.* The Irish for hemp is *cnaib*, *canaib*.

The linen manufacture languished in Ireland during ages; and early in the 17th century, Peter Lombard lamented that this country had not the art and industry which prevailed in Holland, in spinning, weaving, and bleaching cloth. Yet, he contends, if the Irish were, in these respects, as attentive as the Dutch, they might, like them, acquire considerable wealth in the flax and linen trade.† Happily for this country, Lombard's opinion of its capability for the linen manufacture was well founded;

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* The Scythians had no graven images in their religion, but worshipped the invisible Deity under three symbols, comprehended in the word *Haman*, signifying no more than a consecration or religious usuage. From the word *Mann*, several large mountains in Ireland receive their name; of one, *Sliabh-na-Mann*, in the county of Tipperary, there is an old Monkish fable in every one's mouth. That mountain, say they, was first inhabited by foreigners, who came from very distant countries, and taught the Irish the art of *Osbiris* or *Ouris*, that is, the management of *flax* and *hemp*, of cattle and tillage. The term, Ouris, now means a meeting of females at one house or barn, to card a certain quantaity of wool, or to spin a quantity of flax. Wherever there is an *Ouris*, the *Mann* comes invisibly and assists them. Collectanea de Reb. Hibern. Vol. IV. Preface, p. 8.

† "Non illa ars est et industria quæ in Belgio in nendis, texendis "aut dealbandis telis. Quæ sane si adesset, sicut Belgis ita et Hi"bernis divitias magnas adferre facile posset mercatura lini et tela"rum." De Regno Hiberniæ Sanctorum Insula, Commentarius, &c. p. 90.

ed; and since the year 1636, about which time Lord Strafford gave it new life, it has advanced with rapid strides to its present state of extensiveness and excellence.

To obtain satisfactory information relative to the various states of our linen manufacture, from its early days until the period of its revival, the necessary documents, I believe, are not to be had. The only method within reach, by which any idea on the subject can be acquired, seems to be that of taking a survey, which must here be a brief one, of the dress worn in Ireland at different times. This may also bring into view not only some particulars respecting other arts, but specimens of the customs and manners of the people in those days, which may at least interest our curiosity.

The ancient Irish dress, concerning which we have the best vouchers, consisted of the *truis* or strait *bracca*, the long *cota*, the *cochal*, the *canabhas*, the *barrad*, and the *brog*.*

The *truis* or strait *bracca* was made of weft, with various colours running on it in stripes or divisions. It covered the ankles, legs, and thighs, rising as high as the loins, and fitted so close to the limbs, as to discover every muscle and motion of the parts which it invested.†

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* Walker's Historical Essay on the Dress of the Irish, p. 2, 3.

† Dr. Ledwich, (Antiquities, p. 344.) supposes that the Irish trowsers were denominated *braccæ* from their shape, and not from their colour, because *broeck* is a Teutonic word, which *latinized*, is *bracca*.

The *cota* was a kind of wide jacket, made of thin woollen stuff plaided, or of *linen* dyed yellow. Walker calls it a shirt. It was sometimes denominated *squird* or shroud, from its enclosing the body, and was the general dress of the chiefs and nobles; hence called by the old Irish, *conach*, *eneach*, or *dun-latha*, i. e. the dress of the chief. This garment was open before, and fell below the waist so far as to admit of being occasionally folded about the body, and made fast by a girdle round the loins. The sleeves of some were short, of others long, reaching to the wrist. Formerly not only in Ireland, but in Gaul and in the Highlands of Scotland, there was no dress worn under the cotas, which may be termed a sort of *spencer*.*

The custom of dyeing this part of the dress yellow, Spenser thinks, came from the east; but the reasons he gives for the use of it there, have not the sanction of modern knowledge, viz. because in hot countries this colour prevents the evils proceeding from profuse perspiration, and from long wearing linen. Lord Bacon assigns other reasons for the adoption of this colour by the Irish, namely, its continuing not only longer without shewing the dirt,

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[illegible] But, setting apart the violence thus done to etymology, it appears from the best authority, that the garment was so named, "quippe ex panniculis sive plagulis diversis factam," because it was made with different small pieces or stripes of cloth. Besides, [illegible] is the Irish for speckled, spotted; hence *breacan* a Highland plaid [illegible] ng from the root [illegible] to embroider, to paint. [illegible] ns of a Dictionary, p. 18, 65.

[illegible] l Essay, p. 3, 34

dirt, but its contribution to longevity; in both which he likewise fails in giving satisfaction; for yellow exposes the dirt at once, and there is not the smallest proof of its tendency to prolong life.*

It has been alleged, that the ancient Irish dyed or stained their garments yellow with saffron; but this opinion does not seem to be well supported, as the saffron plant probably is not a native of Ireland, nor naturalized in those early times; the name of one place in the country, Castle-saffron, appears to be of modern date; and as an article of importation, there is no reason to suppose that saffron was at any time cheap enough for general use. It is on the contrary to be assumed as a fact, that they communicated the yellow colour with indigenous plants, in which the country abounds. Lady Moira conjectured that, instead of saffron, they dyed their linen with a kind of lichen, prepared in the manner of archil; but this plant imparts a madder-red to woollen, and is not by a simple process applicable to colouring linen. Our ingenious and public spirited country-woman, indeed, does herself observe, that the shade of yellow, which it affords, borders on an orange brown; and afterward she informed Mr. Walker, that the yellow dye, which the

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* A Portuguese physician attempted to account for the use of the yellow dye, by alleging that it was worn as a vermifuge. He first should have demonstrated that all the people were infested with worms.

Irish struck, was produced from a kind of lichen, the very same with that supposed to yield the yellow.*

Several indigenous plants are applicable in communicating a yellow colour to linen and cotton, among the principal of which are the yellow weed *(reseda luteola)*, the tops of yellow lady's bed-straw *(gallium verum)*, and juniper or cypress moss (lichen juniperinus). Common *astringent* vegetables also, which are very numerous, furnish a yellow colour, not of much brilliancy, but of sufficient fixity to be used with advantage. Green oak bark unites perfectly with yellow weed; and by this mixture, or similar ones, together with the oxyd of iron may be combined vegetable colours, the splendour of which is equal to their durability. The oxyd in vegetable acids injures the cloth less than in mineral, and for this reason, the acid of sorrel, a plant too, very useful in the whole for dyeing, seems particularly eligible to prepare the oxyd. But the ferruginous mud, already in a state of oxydation, used time immemorial in Ireland, answers the end of a technical preparation.

The leys used in the process are made with vegetable

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* The lichen here meant, as I have elsewhere observed, Derry Survey, p. 197), is the species called *Omphalodes*, which has been ascertained from a specimen sent to an eminent botanist in Dublin, the ingenious Dr. Wade, in whose instructive correspondence I have the honour of participating. The *lichen tartareus*, stone-rag, or Welsh liverwort or cupthong, with volalkali alone, or with this alkali and lime, yields a purplish red. Kilkenny Survey, p. 173. All this order of plants afford valuable dyes—*calcarius*, a scarlet; *candelarius*, a yellow, &c.

table and mineral alkali, viz. weed or wood, ashes and kelp, both which may have been early known in this country, since the materials of which they are made, are very common; the former, indeed, must have been familiar to the people in the earliest times, on account of the common rustic usage of burning weeds, and the old practice of consuming woods and forests by fire; the latter, or the kelp, might be discovered from using some of the dry sea-weed for fuel. After combustion, curiosity might lead to taste the ashes of both, and finding them pungent, an idea would start of their being applicable to some useful purpose, to ascertain which trials would consequently be made and discoveries ensue. Alum is likewise employed as a mordant, which they might have easily got from abroad, or perhaps been supplied at home, as here are found earths strongly impregnated with this substance. Or instead of these materials, others, now unknown, might have been employed with equal advantage.*

In Sir William Petty's time, about 130 years ago, the Irish were in the habit of using alum, madder, and indigo, which they imported. For dying both their linen and woollen cloth, they employed the bog-mud already mentioned, saw-dust, the rind of several trees, bucthorn berries, and green weeds of which they had abundance. The mud, he remarked, served them for copperas, a ferruginous oxyd, (sulphat of iron),

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* Withering's Botanical Arrangement, Vol. II. page 716. Philosophical Magazine, Vol. I. page 430. Id. Vol. II. page 59, 60.

iron), and the saw-dust for galls; but surely they needed not to have been at a loss for plants containing the astringent principle, such as heath, gale or bog-myrtle, tormentil, &c. &c.

Though Spenser's notion of the motives for adopting the yellow colour in the east is not admissible; yet it is reasonable to conclude that the emigrants, from that quarter to Ireland, brought with them the art of dyeing cloth, along with other arts practised in the country whence they removed. In a very early period of Irish history, we are told, that Tighernmas ordained a sumptuary law, called *Ilbreachta*, according to which the different classes of the people were to be distinguished by the number of colours in their garments; which is a strong circumstantial proof that the art of dyeing was then well understood. Hence we may readily believe, as it is recorded, that at the same time the methods of dyeing purple, blue, and green were known in Ireland; which, it is said, Tighernmas introduced; but which, it may be presumed, he only revived, if it be admitted that the Iberno-Scythians preserved the oriental art of imparting various colours to cloth.*

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* Walker on Irish Dress, page 16, 17. O'Connor's Third Letter, Collect. Hibern. Vol. IV. page 125.

The basis of all the different colours given to Morocco leather in the Taurida or Crimea, Astrican, and the other cities formerly belonging to the Tartar empire is a strong decoction of southernwood. This remained a secret till discovered by Mrs. Guthrie, and lately published in her letters. Some preparation is given to the skins, previous to the use of the colouring matter. For red, some cochineal is

added,

But to return to the articles of dress: the *cochal* or *cocula* was the upper garment; a kind of a long cloak, with a large hanging collar or hood of different colours, which, in latter times, consisted of many rows of shag or fringe worn partly for ornament, partly the better to defend the neck from cold, and along the edges ran a narrow border of the same texture. This garment only reached to the middle of the thigh, and, being brought over the shoulders, was fastened on the breast with a clasp, a button, a buckle or *dealg fallaine* or broche; the body as well as the collar was surrounded with a fringe like rough woolly hair. It is supposed that the several colours in this garment were either owing to stripes of various hues introduced in the weaving, or wrought with a needle.

The *canabhas* or *fillerd* or *philleadh* was a large loose vesture, not unlike the cochal, and probably often worn as its substitute. Being thrown on the shoulders, it spread over the whole body, and when the hood of the cochal was drawn over the head, served to disguise the wearer. We shall hereafter find this garment mentioned by Cambrensis, who calls it *phalinge*, made, in his time, with coarse woollen cloth, coloured black or purple. In the middle ages, this robe when worn by royal personages

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added, together with alum, and an infusion of oak leaves. When a yellow colour is intended, the southernwood is used without cochineal, but not without alum and infusion of oak leaves. Both colours are finished by rinsing, oiling, and callendering.

images is represented of a flowing length, and, like the royal robes of the east, was dyed a crimson colour.

The *barrad*, to which the Irish were very partial, was a conical cap, not unlike the foraging caps at present used by some of our cavalry, and of late years sometimes seen on the peasantry in the south of Ireland. In the early ages, the cap of the Irish, like that of the Egyptians, might have been one of the distinctive marks of rank in society, and probably varied in its form and ornaments accordingly. The Scotch bonnet was also formerly in use in this country. During several ages, the inhabitants of Connaught wore no other covering on the head than the hood of the cochula, fastened under the chin; or a *cailleach* or *kercher*, flowing fromthe crown of the head down on the shoulders. This covering for the head was worn equally by both sexes, but usually by the men, in the form of a turban. In the same province, the barrad at present is tight like a scull-cap.*

The

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* Walker on the Irish Dress, page 5, 6, 8. Id. Additional Notes, page 86.

The *Brog* not being connected with the linen or woollen manufacture, is of course passed over without any particular notice on this occassion.

It would be surprizing, says Dr. Ledwich, (Antiquities, page 340), to find among the rude Irish any thing like the *pileus* and *petasus*, which the Greeks and Romans long wanted. But what degree of comparative civilization is to be deduced from the difference of dress in different climates, different governments, and different tempers of people? The climates of Greece and Italy are different from that of Ireland; in the political establishments of the countries any striking traits of similarity have not been discovered; and in the dispositions of

The dress of the Druids was uniformly and universally a white garment, designed to be emblematical of the purity of their mind:

> "His robe of purest white, though rudely join'd,
> "Yet shew'd an emblem of the purest mind."

This snowy robe probably was made of linen, as a woollen stuff could not easily be preserved in such a state of whiteness; and if so, it may be inferred, that even in those days they had the art of making linen cloth of a fine texture and a bright colour. Whether the mantle or cassoc of the *ollamh*, i. e. doctor, which was denominated *suadh*, was a linen or woollen fabric, I cannot determine. The females wore large veils, which, it is likely, were made of linen.*

Towards the end of the second century of our æra, the fashions in dress had become so extravagant and costly, that, in the reign of Mogha Nuadhad, it was found necessary to enact a code of sumptuary laws, which preserved the regular spirit of the *Ilbreachta;* a spirit which was maintained through several Pagan ages, and which evinces the civilization of those times,

of the people few or no parallel lines can be traced. The famed pileus resembled our common night-caps, and the celebrated petasus was like a broad-brimmed hat. Considering every circumstance, the *barrad* or *birred* of the ancient Irish has as good a claim to being a mark of civilization as those head-dresses belonging to the Greeks and Romans. In fact, with regard to dress, these admired ancients were but slovenly and frowzy creatures.

* Walker on the Irish Dress, page 9, 10, 13. Vallancey's Vindication, page 106.

times, since it must be allowed that laws, founded on social order, are incompatible with a state of barbarism, even were they not honoured by methodical observance. For in what nation, though advanced to a refined state of civilization, are the laws punctually obeyed? However, those sumptuary laws did not prevent the higher orders of the people, after the establishment of Christianity, from becoming very expensive and splendid in their attire; and of course this propensity to extravagance spread among the lower orders in proportion to their circumstances. In the book of Glendalogh, ascribed to Benin, the disciple and successor of St. Patrick, we find mention made of scarlet silk cloaks, rich embroidery, gold-hilted swords, horses magnificently caparisoned, &c. Allowing that all this finery was from foreign sources, we may discover in a work of Tacitus, a Latin writer in the end of the first century, through what channel it was obtained. He observes, that in soil and climate, as also in the temper and manners of the natives, Ireland differs little from Britain; whilst both the navigation to it, and its harbours, are better known, on account of its commercial intercourse.*

Near

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* "Solum cœlumque et ingenia cultusque hominum haud multum "a Britannia differunt: melius aditus portusque per commercia et "negotiatores cogniti." Vita Tull. Agricolæ. Walker on the Irish Dress, page 18.

According to the Irish Annals, A. D. 192, the price to be paid for clothes by all orders of people was fixed by the above sumptuary law. Thus the price of a queen's cloathing, who had brought a

dowry

Near the close of the 5th century, St. Patrick founded here the monkish profession, which, again the 7th century, increased to such a pitch that the progeny of monks became equal to all the other inhabitants of the kingdom. It is worth while, therefore, to take a peep at the nature of the habiliments which they wore, as they must have had considerable influence on the manufactures and trade of the country. The *Benedictine* monks wore a black loose coat, or gown, of stuff, reaching to the heels, a cowl or hood of the same, and a scapulary; underneath they had another habit as large as the former, made of white flannel. The nuns of this order had a black robe and scapulary; under which was a white woollen tunic. The *Augustinian* canons were habited in a long black cassoc, with a white rocket, and over that a black cloak and hood, with caps on their heads; when reformed they were forbid linen. The habits of the regular canonesses of this order, was the same colour as that of the canons.

The habit of the *White Canons* was a white cassoc, a rocket over it, a long white cloak, and a cap of the same colour. The *Gilbertines*, on the contrary, were attired in a black cassoc, with a white furred cloak,

dowry, was then six cows, or two *cumals*, as they were called; but if she brought no dowry, the payment was to be made in proportion to the value of the clothing. This clothing might consist of body clothes, a golden head-dress, a golden veil, &c. The value of embroidery was regulated by the old law; and divers colours on scarlet silk were to be paid for according to the merit of the work. Collect. De Reb. Hibern. Vol. I. p. 658, 663.

cloak, and a hood lined with lambskin. The *Cistertian* order, or the monks of *St. Bernard*, wore a white cassoc, with a narrow scapulary; when they went abroad, they put on a black gown; but when attending the church, they used a white one. The nuns wore habits similar to those of the monks. The *Dominicans* were named *Black Friars* from their habit, which, when they went abroad, was a black cloak and hood over their white vestments, and in their convent they wore a white cloak and hood. The *Franciscans* were called *Grey Friars* from the colour of their garments, which consisted of a loose gown reaching to the ankles, with a cowl of the same stuff, and, when they went abroad, a cloak; they girded themselves with cords, and went barefooted. There were several other orders, military as well as religious; but this sketch will suffice to give an idea of the effects, which the consumption of those considerable societies would have on the articles composing their dress.

As to other ecclesiastics, we are told, that, in the middle ages, not only the Irish, but the Anglo-Saxon clergy, went very indecently clad, wearing only a short woollen mantle, and leaving the rest of the body bare, to display the ornamental punctures on their skins. Hence we find a canon of the 8th century decreeing, that every clerk, from the door-keeper to the priest, who shall be seen without his tunic, and who does not cover the nakedness of his belly, shall be separated from the church*.

The 10th century was an age of great splendour; in which respect it appears that the nation underwent considerable alteration before the time of Cambrensis, who represents the Irish dress as mean and rudely fashioned. They were, says he, light cappuces, or capuchins, which spread over their shoulders, and reach to the elbow. These upper coverings are for the most part made with cloth of different textures, and different colours, sewed together into stripes. Under these they wear woollen *filleadth* or fallings†, instead of the pallium or mantle, besides large loose breeches or trowsers, and these generally dyed. He reports, that the Irish neither manufactured linen nor woollen cloth; by which must be understood, that they did not manufacture either in such quantities as to export them to other countries;

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* Archdall's Monasticon Hibernicum, Introduction, p. 17, 23. Ledwich's Antiquities, p. 332, 3.

The dress of the ancient Irish priests were *white linen*; they of the old Scythian order wore the *sudar* or girdle; they of the Tuatha Dadanu wore the *mallain* or mantle.

† This name for a cloak or mantle comes from the Irish word *fallann* to hide, conceal. Vallancey's Prospectus, F. A. L. p. 39.

The word used by Cambrensis for cloth is *pannus*, which may indicate either linen or woollen; here probably it signifies woollen, as the stripes were different colours, and woollen is easier impregnated with colouring matter than linen. The trowsers being also generally dyed, when that was the case, they probably were made of woollen stuff; perhaps they were a thin woollen fabric of the serge kind, which the Irish early manufactured, and for which they were celebrated down to the 15th century.

tries; for surely it is reasonable to believe, that they were at least capable of making the sorry stuffs with which he says they are clad.

The same writer tells us, that the colour of the Irish dress is for the most part black, because their sheep are black; and Dr. Ledwich accounts for the preference given to black by saying, that they used it to conceal themselves in their bogs, their constant retreats, which he alleges are black; whereas the fact is, that bogs being covered generally with heath or coarse grass, are brown or a muddy green. The Doctor attempts to illustrate his doctrine by assuming, that the colours of animals are naturally changed for their greater security; thus hares, continues he, put on a white colour in winter where snow abounds, to elude their sharp-sighted enemies. But how shall we reconcile this cause of the phenomenon with that of the white colour of bears in regions of eternal ice, where the sharp-sighted enemies meant by the Doctor cannot approach them? Animals change the colour of their hair, fur, &c. by physical laws proceeding from constitution, climate, &c. not from a moral or instinctive cause, such as the approach of enemies, and the like. Men, indeed, have grown grey-haired in the space of a night; but this proceeded from the long-continued influence of moral causes producing an alteration in the corporeal system, which brought about the physical effect.

Where, however, is the instance of a hare growing white on the fall of a snow-shower? Nay, should not the animal, if the Doctor's principle were just, often turn green in these islands, to facilitate its escape from its eager and sharp-sighted enemies?

But however coarse and uncouth the garb of the people at large then was, the apparel of the chieftains was rich and in the gaudy taste of the times. It appears that, in the 14th century, the habiliments of the chieftain were the shirt or wide jacket, and the robe fastened on the breast with the broche; whilst pantaloons, hose and shoes, were articles of dress, which, like the ancient Romans, they affected to despise.

In the 15th century the ladies wore a veil, termed in Irish *fillag**, and denominated by the English a kercher or kerchief, which probably was made of linen, since in England it was then made of this material, and worn by both sexes. Under the veil the Irish women wore the cochal, coculach or mantle; and beneath this, on the shoulders, they wore the cliobach or cloak. In the same century we find

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* *Fillag* is the diminutive of *filleadh-beg* or *fillea-beg*, which signifies a little plaid, wrapper, or shawl. *Filleadh* is from *fal*, a division; the *plaid* has its root in the Chaldee *plad*; and the Arabic *filut* may be also the origin of the *fillead* or *filleadh-beg*; both which signify a small narrow garment. This garment is said to have been of the *Tartan* kind, that is, striped or chequed; and if so, the *fillag* might have been made of woollen as well as linen, since the tartan was probably a mixt stuff, linen and woollen, or linsey-woolsey, such as the generality of Highland and Irish plaids are. Vallancey's Vindication, p. 118. Prospectus, p. 39, 62.

that the ministers of the gospel, even in those days of simplicity, and the females who abjured the busy haunts of men, were no enemies to the glare of dress; for it appears that, in founding abbies, sanctuaries were provided to contain *cowls* for *friars*, and *veils* for *nuns*, costly and beautifully wrought; the former perhaps were woollen, the latter linen.

In the 15th century likewise, an act of parliament passed at Trim, restraining the natives from wearing shirts coloured with saffron; yet they continued to imbue their shirts with this dye so low as the reign of Elizabeth. At the same time, the ladies were permitted to indulge their fancies; and they wore a cap, called in Irish *curach*, by the English termed cornet, bound round the forehead with a fillet richly ornamented, named by them *cabhien* or *ciebhien**, and by the English frontlet. Over these was thrown the veil or kercher; and the kertle constituted the gown or flowing robe. The taste of the times certainly led to great expense, such as cloth of gold, tissues, silks, &c.; and among the rich, the importance of girdles is a collateral proof of the loose garments worn in that age; those of men appear to have been woollen.†

In the 26th of the reign of Henry the Eighth, (1535), it was enacted, that after the year 1539, none of his Majesty's Irish subjects "should use or

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* *Caveen*, a name at present for a man's hat.

† Walker on the Irish dress, pag. 23, 47, 68. Id. pag. 49, 51.

"weare any shirt, smock, kerchor, bendel, neckerchour, mocket or *linnen* cappe, coloured or dyed "with saffron, ne yet use, or weare in any their "shirts or smockes above seven yards of cloth, to be "measured according to the king's standard," under the penalties of fines and forfeitures for transgressing. In that age, the works of the loom were the employment of the women, who were by statute-law forbidden to frequent taverns, under a penalty of twenty shillings for each infringement, and on the contrary were ordered to occupy themselves in making both woollen and linen cloth. On this law it is justly remarked, that as well in the early as in the middle ages, the shuttle was usually thrown in Ireland by the hands of the fair; and that, in those simple ages, almost every female accomplishment had utility for its object. In Spenser's time, near the end of the sixteenth century, the women wore great *linen* rolls on their heads, to keep them warm after cutting their hair, which they were wont to do in any sickness. He mentions also the use of thick-folded *linen* shirts, long-sleeved smocks, &c.

In the year 1562, we are informed by Camden, that the *galloglachs*, or battle-axe or body guards, remarkable for their great stature and strength, who attended O'Neal, prince of Ulster, to the court of Elizabeth, wore surplices, or large cloaks with long sleeves dyed with saffron. These troops also sometimes wore the haubergeon, a species of military coat composed of several folds of coarse *linen*, or *hempen* cloth, with iron net-work or plates ingeniously placed in the folds, and secured from hurting the wearer, by wrappers of paper and wool, quilted through the cloth with small pack-thread. There was also a celebrated denomination of troops, called *kearns*, who were desperate fighters, as the etymology of the name implies.* A third description of troops was distinguished by the appellation of *fiann erin*, *fearg*, *feine eirin*, or *cul-fiana*; they were the ancient militia of Ireland, and were appointed to defend the coast against invasion. They were spear or dart-men; and their commander was the renowned *Fion Mac Cumhal*, *Finmacool*, or *Fingal*, concerning whom many fables have been written in succeeding ages.†

Morryson, writing in 1588, informs us, that the Irish gentry wore close breeches and stockings in one piece, (pantaloons), made either of red or some light coloured cloth. They likewise wore a loose coat, with a triangular mantle, commonly of coarse thin stuff *manufactured at home*. Their linen was coarse; their shirts contained 20 or 30 ells, folded in wrinkles, dyed with saffron, and worn in a very slovenly manner, a shirt, according to his report, being seldom put off until it was in rags. The women wore many ells of linen on their heads, rolled up in a form resembling a turban, as noticed by Spenser. This mode of covering the head, which probably had prevailed, time immemorial in Ireland, so perfectly resembles the head-dress of the Egyptian Isis, that it cannot be doubted but that the customs of the Egyptians were preserved among the Irish; "the covering of the head with the rolls or folds "of linen being so noted a mark of the eastern customs, "that its source cannot be disputed, for there (the "east) the heat of the sun required that precaution."

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* The name is derived from the word *cearn*, the place of sacrifice, i. e. an altar, whence *cearnac*, the sacrificing priest. This word, though the same sound, is different in meaning from the word *carn*, which signifies a heap or pile of stones raised as a monument for the dead. From the former word comes the title of the troops, viz. *kearn* or *cearn*, a vehement soldier, a slayer. Vallancey's Prospectus, Introduction, page 18.

† Walker on the Dress of the Irish, page 59. Walker's Memoir on the Armour and Weapons of the Irish, page 109, 124.

"Whilst Morryson's account may be admitted in general, it must be remarked, that he makes an assertion obviously at variance with nature and reason: "the very chiefs of the Irish," says he, "as well men "as women, goe naked in the *winter* time." The climate of Ireland, in all ages, especially during the *winter* season, must have forced the most barbarous to some covering, even in their closest apartments; and it is not reasonable to suppose, that, in the 16th century, the chiefs of a people, connected with civilized nations, would so far neglect the influence arising from dress as to go naked, even in the hottest moments of summer. It is indeed probable, that all classes of the Irish were reared in a hardy manner; and it appears, that the poorest classes, though they did not imprison their new-born infants in swaddling clothes, took care to wrap them up in a warm blanket.*

Speed, the historian, who died in 1629, gives a description of the Irish dress, which is considered accurate. Amongst other things, he observes, the men wore *linen* shirts exceedingly large, stained with saffron, the sleeves wide, and hanging to their knees, strait and short trusses plaited thick in the shirts, their breeches close to the thighs, and a mantle which was generally thrown over their heads. The women wore folded wreaths of *fine* linen, rolled about their head, and over their side garments the rough rug mantle, edged with a deep fringe of divers colours.

The cap, mantle, and trowse had been prohibited, but were not fallen into disuse in the year 1672. Those used by the peasantry were made of a narrow sort of frize; and their clothes, in general, were manufactured with yarn spun by themselves, from the wool of their own sheep. At the same time the tradesmen's wives, who, no doubt, imitated the higher ranks, wore not only silk gowns, but two or three silk petticoats; and even inferior classes were so ridiculous as to put on silk hoods and scarfs.

Respecting the dresses worn in the contentious time of James the Second, little is known with certainty as to those that predominated. If any particular fashion prevailed, we may presume that it was derived from the British; of the female peasantry, however, some still continued attached to their old mode of attire; and among the inhabitants of the remote mountainous districts in our island, remnants of the ancient dress may be traced to this day. In the year 1754, the natives in the Rosses, County Donegall, where the features of the country display the wild sublimities of nature, had no more than two garments, and those of flannel manufactured by themselves; the men, a waistcoat and breeches; the women, a gown and petticoat: but there was no linen amongst them. Although there was a seeming neglect of their persons, they were not without a spice of vanity, displayed by their fondness for a diversity of colour in their clothing, which they dyed with materials the produce of their own soil. The principal of these were already mentioned, viz. the masses, the mud or *mireblack* as they call it, &c.* In this district, they were then, and still are, famous for knitting woollen stockings, of which they annually sell considerable quantities, and of which a single pair for a man, of an excellent quality, can be bought for 3*s.* 3*d.*

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* Walker on the Dress of the Irish, page 61, 63.

In solitary and unfrequented districts, the natives, especially the women, at this day, wear some garments resembling those of their ancestors, viz. the kercher and the mantle. The kercher is called, in Connaught, *binnogues;* and there the mantles are blue.* The former is sometimes linen, sometimes woollen; the latter is a square piece of woollen stuff coloured or plain; and when this is not at hand, they throw a drugget petticoat over their shoulders, calling this covering, in some places, a *keedong*. The men, however, shew little or no remains of the primitive dress, having conformed to the modern customs of their more enlightened neighbours; and it may be said, that both sexes have universally adopted the use of linen under-clothing.†

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* Walker on the Dress of the Irish, page 64, 73. Id. Appendix page 144, 145.

From the whole of this section we may conclude, that the inhabitants of Ireland were early acquainted with the methods of communicating various colours to woollen stuffs at least; that those colours were then imparted, by means of indigenous materials; that the manufacture of linen, and perhaps of hempen, cloth was in old times tolerably well understood in this country; and that the home consumptioon of the former was often considerable. If Ireland, until within fifty years past, was not distinguished for the manufacture of linen, it does not follow that, in preceding times, she was incapable of carrying on the business; it merely indicates, that, owing to certain circumstances, she did not export cloth, so as to acquire among nations the high character which she now enjoys in the trade; for it is only by foreign commerce that such distinction is obtained.

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* Walker on the Dress of the Irish, page 86, Notes.

† *Keedong* seems to come from *keadac*, which signifies cloth in general, and linen cloth in particular, the *pannus* of the Latins. But here it may signify woollen cloth, as its root may be in *Kent* sheep, and *oige* cloth, woollen cloth; in which case, *keedong* or *keadac* may denote a small blanket.

For carrying on the linen manufacture, Ireland possesses many obvious advantages. Independent of the aptitude of its soil and climate for the growth of the flax plant, as well as for the growth of innumerable others of the vegetable race, a very strong recommendation of the manufacture is, that its raw materials can be raised in the country. They are not foreign, like those of cotton and silk; nor to be found cheaper and better in another country, like those of wool and iron. The finished goods, too, are such as are always sure of being in demand at home; for the use of linen is indispensable to cleanliness and comfort, and depends little on the caprice of opinion for recommendation. Being also a manufacture which is not exposed to the changes of taste and fashion, it is sure of finding a market in foreign countries, wherever it cannot be produced cheaper. It is moreover a manufacture, which, by the production of its raw material, promotes agriculture; and thus is formed a connexion of the utmost general importance, inasmuch as the extension of one branch of rural economy conduces to the extension of every other, whilst the reciprocal advantages of progressive manufactures and husbandry, have their full operation.*

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* Wallace on the Manufactures of Ireland, Part II. Sect. 1

NOTE.

It was the custom in Ireland to make all dresses for the dead with linen, until the beginning of the 18th century, 1703, when a law was enacted, forbidding its continuance, and enjoining the employment of woollen in its stead, as practised in England. The difference of usage in this particular being considered very trivial by Dean Swift, he makes use of the circumstance to shew the folly of forming national distinctions, as too often done on the pettiest pretences, even where there is the strongest community of interests. Thus, says he,

> " We bury, on our side the channel,
> " In linen, and, on yours, in flannel."

But there is every reason to expect, that the principles on which the recent UNION was founded will have such vital operation, as effectually to prevent in future all notes of distinction between the two kindred isles, and that the people may truly exult in the event, declaring in the words of James I. when the crowns of England and Scotland were united in his person,

> " *Jam cuncta gens una sumus, sic simus in ævum.*"

which, paraphrased in English, may be applied to the still more essential Union of Great Britain and Ireland as follows:

> *England*, *Scotland*, and *Ireland*, kingdoms erst three,
> One UNITED KINGDOM we now happily see,
> And may they unshaken for ever thus be!

Surely it requires no arguments to demonstrate, what is too manifest to escape the plainest observer, that *now* it is the *interest* as well as the *duty* of the *whole* to bury for ever all political differences—all local prejudices; to consider the EMPIRE, not as composed of distinct political bodies, each having views incompatible with the happiness and prosperity of the rest, but as containing only ONE PEOPLE, united in *interest* as they are in *dominion*.

" Then would the *sister isles*, amid their seas,
" Like the three Graces in harmonious fold,
" By mutual aid enhance their various charms,
" And bless remotest climes.—To this lov'd end,
" Awake, BENEVOLENCE; to this lov'd end,
" Strain all thy nerves, and every thought explore!"

SECT. VI.

" While the claims
" Of social life to different labours urge
" The active powers of man, with wisest care
" Hath nature on the multitude of minds
" Impress'd a various bias; and to each
" Decreed its province in the common toil."

AKENSIDE.

OUR wants and desires are so various and of such a tendency, that they concur in turning our attention without ceasing to the objects around us. But as it is certain that our task of acquiring the knowledge of external things is extremely diversified, and that our power must ever be in proportion to our knowledge; our Creator, whose providence is manifest in all his works, has implanted in our minds a love for making discoveries, together with a principle of disinterested and laudable curiosity. This principle, as far as it is necessary for the general purposes of life, is a cause of action in all men; whilst in some, it is so prompt and paramount as to be the motive influencing all their pursuits.

The first acquisition of the human mind will be that of arts; or the knowledge of means conducive to certain ends; but, as men improve their situation, and become more at ease, especially after the introduction of *agriculture*, and some other useful arts, they will find more time to study the nature and property of things; or the study of nature will become the object of pursuit to some men; whence arts, which are founded on knowledge, are gradually exalted into sciences.*

No man has a capacity able to embrace all the objects at which his mind may grasp; science therefore has attained its present advanced state in consequence of different philosophers having been led to different paths of inquiry; it will continue to advance still farther, by the improvement of arts, which will be daily furnishing it with new objects, and new discoveries. This progression of the arts will be accelerated by the artists calling on a set of men to think for them, leaving no more in their own hands than the execution of the orders provided by the man of study. Thus, both art and science will most successfully improve, by acting in concert, and those sciences, which are most immediately connected with the arts, will experience the greatest advantages.*

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* "The arts themselves being nothing else than the application of "the laws of nature to *particular* cases, it was soon found that a "knowledge of these laws, independent of, and abstracted from, "any particular use, would render their application in various *other* "cases much more certain and easy than it could be under the "guidance of blind and fortuitous experiments. Hence a connexion "of ſome kind or other, whether real or imaginary, betwixt known "facts, began to be traced, and thence the *Sciences* originated."—— Kirwan, Trans. R. I. A. Vol. V. *Science*, p. 3, 4.

Tradesmen or practical artists are too apt to entertain an illiberal and hurtful jealousy of literary men. Whereas the labours of the mechanic and the philosopher, or those of the hand and head, ought to unite in order to conduct a work of public importance to its point of greatest utility. It is true, the most useful discoveries have at first fallen in the way of mechanics or manufacturers, while engaged in the various operations which their employments require; but their merit consists principally in remarking and following phenomena, until they produce from them some apparent advantage. If they are so fortunate as to succeed, they usually keep their discoveries secret, for the purpose of enjoying a monopoly of their benefits. On the contrary, the philosopher, or the man of a scientific turn, no sooner hears of a new discovery, than he wishes to have a share in the honour of making it known; in which respect his zeal is proportioned to the importance of the invention, and the care with which it is concealed; for, in general, he can gain only by rendering it public.

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* An instance of the advantages, derivable to the useful arts by the application of science to them, is manifested in the case of the mathematical sleaing tables, invented in 1710, by Mr. Beaumont. By these tables the most ignorant weaver is infallibly directed in that important object, the adjustment of the reed to the yarn. By them also any person may soon learn to judge of the quality of cloth; and on the principles there laid down, are constructed the magnifying eye-glasses for ascertaining the hundreds of the cloth, or the number of threads in the reed in which it was set; in a ten hundred reed are twenty hundred threads, but it is called a ten hundred web.

The man of science, indeed, has an advantage over the mechanic or manufacturer, as his exertions seldom fail of being approved, because, by endeavouring to diffuse an important benefit, he appears in the character of a friend to his country and to mankind; and may thus place the conduct of the mechanic or manufacturer in a disadvantageous point of view. This opposition of private interest, whilst it is at variance with the strict principles of liberality, proves serviceable to the community of which both parties are members. When the mechanic or manufacturer makes discoveries, the man conversant in literature must be employed to lay them before the public; by his means they are rendered useful; he prevents their being hurtful by monopoly; he secures them from dying with the discoverer; and, by investigating the principles on which they depend, he makes their benefit to mankind more certain, and shews how they may be applied in various cases of which the mechanical artist never had an idea.

If by these measures the scientific man lessen the merit of one manufacturer, he on the other hand points out employment to many; and gives rise to establishments in which thousands participate, and by which they acquire riches. Upon the whole it is plain, that genius, philosophy, and dexterity of manipulation should co-operate, in order to bring an invention or discovery to its greatest height of perfection and usefulness.*

Since the days of Bacon, the philosophers of Europe have employed themselves in determining, by actual experiments, the physical properties of matter, and the laws to which it is subject; not merely to gratify a harmless and commendable curiosity, but with the avowed intention of reducing to a rational and solid system of principles, the various arts, manufactures, and economical processes which, before that period, depended almost wholly upon chance or caprice. To the result of philosophical experiments we owe the present advanced state of science, and the many improvements which have been introduced into the manufactures of the United kingdom,

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* Philosophical Magazine, No. XXX. page 167—8.

Not only in relation to the arts, but in regard to morals, politics, and all social structures, particular and general labours must concur, to advance them to their capable excellence; because it is from the conjunction of individual and public exertion, directed to the best interests of mankind, that nations can rise to pre-eminence in wisdom, worth, and true prosperity.

dom, and which have gained them the distinguished character they enjoy.

The author of these pages has studiously endeavoured to bring those two powerful allies, art and science, into general co-operation in the undertaking; at the same time he candidly acknowledges that the practical parts of the subsequent observations on planting, he cannot recommend from the results of his own experience; but he can with truth affirm, that he has carefully drawn them from the best authorities, and, he trusts, that they will be found to bear internal evidence of the authenticity of their sources. Tasks of this kind are attended with more trouble than credit; yet the gratification felt in making *selections* is not small, and affords some requital for the time and pains taken in the composition. Thus to have detached from a mass of mingled materials those that are useful, and to have moulded them into a suitable form, are exercises of the intellect on which it reflects with pleasure, and in that pleasure lies the primary reward. Other returns also may be derived from the justice and candour of readers, who are not insensible to the equity of claims founded on a basis of this nature.

If all that might be done on the subject at large be not here performed, it is presumed that there is as much done as will at least have the good effect of calling up the reflections of judicious people, and of giving them a direction to interesting objects, to which, before they may have had little or no idea of turning their attention. As to the general aim and tenor of the essay, it is expected that the reader will throughout find it in harmony with the following sentiments:

" For me, 'tis mine to pray, that men regard
" Their occupations with an honest heart,
" And cheerful diligence: like the useful bee,
" To gather for the hive not sweets alone,
" But wax, and each material; pleas'd to find
" Whate'er may soothe distress, and raise the fall'n
" In life's rough race: *O be it as my wish!*"

OBSERVATIONS, &c.

CHAPTER I.

Observations on the Weather, in the Year 1801.

> " The volume of Nature is the book of knowledge; and he becomes most wise, who makes the most judicious selection."
>
> Citizen of the World, Letter IV.

> " Debuerant autem homines, si illis utilia inquirere vacaret, natu-
> " ralia opificia et operationes singulas, attente et minutim, et compo-
> " sito intueri; et secum perpetuo et acriter cogitare, quænam, ex
> " ipsis ad artes transferri possint. *Speculum enim artis natura.*"
>
> Bacon de Dignitat. et Aug. Scient. Lib. V. C. II.

> Men, if they would dedicate any time to useful pursuits, ought to employ their leisure hours in attentively, minutely, and methodically examining the several works and operations of nature; and should constantly and carefully consider what profitable discoveries may be transferred from them to the arts; *for nature is the mirror of art.*

THE city of Derry, where the following observations on the weather were made, is seated on a promontorial tongue of land, elevated about 100 feet above the sea, stretching obliquely from west to north-east, and terminating with a moderate declination in a shore washed by a considerable river; the Foyle. Lat. 55° N. Long. 7° 40′ W.

The barometer, which is an upright one, with a floating guage and a Nonius scale, is suspended in an apartment where fires very seldom are burned. The thermometer, on Fahrenheit's scale, is in the same apartment, and, when used to observe, is placed in the shade, in a window opening to the north-east. The hygrometer is one on De Luc's construction, made with a very thin transverse strip of whalebone, which moves an index round a circular plate, graduated to one hundred; the higher number indicating the greater degree of moistness in the air.

The observations, when made twice a day, are made chiefly at nine o'clock, A. M. and three o'clock P. M.; frequently they are made only once a day, and this sometimes in the morning, sometimes in the evening; but, upon the whole, they are made so often as to ascertain pretty accurately the temperature of the place, and the other states of the air, viz. its weight and dryness with still greater exactness. The winds being often observed, in the night as well as in the day, their direction and changes are fully recorded.

The rain-guage consists of a funnel and a receiver; the funnel is made of tin, with an aperture containing an area of one hundred and forty-four square inches. To the edge of the funnel is soldered a perpendicular rim, an inch deep, and of an area the same with that of the aperture. The water collected in the receiver is measured, once a month, in pounds Troy, which are reduced to cubic inches without the trouble of figures, by consulting a table, formed for the purpose, by Mr. Kirwan, and published in the fifth volume of the Transactions of the Royal Irish Academy.

SECT. I.

TABLE I.

Summary result of Meteoric Instruments.

Months.	Barometer.		Thermometer.		Hygrometer. De Luc.		Rain-Guage
	Max.	Min.	Max.	Min.	Max.	Min.	Inch. Parts
January	30.7	28.92	46½	36	52¼	49¼	4.440152
February	30.25	28.79	52	35	52⅖	47½	3.586286
March	30.45	28.64	61	36	51¼	45¾	3.546877
April	30.59	29.96	71	33	45½	32½	1.734029
May	30.30	29.51	67½	49	35	26½	3.113369
June	30.38	30.8	72	53	31⅕	27	0.788195
July	30.28	29.36	71½	53	38¼	27⅓	3.468058
August	30.44	29.63	76	57	34	27½	0.472917
September	30.33	29.50	69½	52	33½	29	1.221701
October	30.34	29.11	57	40	36½	32½	3.599416
November	30.4	29.15	53	33	40	32¾	2.916321
December	30.22	28.81	42	22	40¾	38½	3.310419
Yearly	Mean 29.83 +		Mean 49+		Mean 39.84—		Total 32.197740

TABLE II.

Numerical Direction of the Winds.

Months	N.	S.	E.	W.	N. W.	N. E.	S. W.	S. E.
January	—	2	—	26	8	1	7	1
February	—	2	9	14	3	4	4	—
March	3	3	—	13	8	1	6	2
April	4	10	—	8	8	—	—	1
May	—	—	4	6	7	6	—	8
June	10	3	1	11	7	—	—	—
July	—	5	1	11	8	2	3	2
August	6	8	7	8	3	2	—	1
September	4	9	6	8	3	3	2	3
October	5	—	—	13	6	1	9	2
November	4	1	3	12	11	1	3	3
December	1	2	5	10	13	2	4	6
Total -	37	46	36	141	86	23	38	29

TABLE

TABLE III.

Synoptical View of common Phenomena.

Months	Fair	Showery	Wet	Hail	Snow	Frost	Aurora Borealis	Thunder & Lightning
January	4	25	2	2	2	4	1	1
February	7	19	2	—	4	3	2	—
March	8	21	2	3	2	1	1	—
April	17	13	—	6	3	1	—	1
May	7	21	3	4	—	—	—	2
June	18	12	—	—	—	—	—	—
July	11	15	5	—	—	—	—	1
August	20	11	—	—	—	—	—	2
September	15	14	1	—	—	—	—	—
October	3	24	4	2	—	—	—	—
November	7	21	2	9	3	2	—	—
December	7	21	3	5	11	14	—	—
Total -	124	217	24	31	25	25	4	7

SECT. II.

" Si vero solem ad rapidum lunasque sequentes
" Ordine respicies; nunquam te crastina fallet
" Hora, neque insidiis noctis capiere serenæ."*
Virgil Georg. Lib. I. l. 425.

JANUARY.

Moon *new*, the 14th; *full*, the 29th.

The commencement of this month was boisterous, but the weather soon grew mild and genial; which temperature, with little exception, it preserved throughout; and some of the nights, particularly at the beginning, were softer and warmer than the preceding days. There were, indeed, several fresh and cool breezes, together with some sharp, but short, congelation, and three or four days of foggy air. On the 4th, a stormy gale, which lasted nearly 24 hours, proceeded from the south-west, and this winter, as well as the preceding autumn, the west winds were unusually cold. The greater part of the rain that fell this month, descended in heavy showers.

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* " Observe the daily circle of the sun,
" And the short year of each revolving moon:
" By them thou shalt foresee the following day;
" Nor shall a starry night thy hopes betray."
DRYDEN.

When the Greek or Roman writers speak of heat, storms, or other changes of the weather, being produced by the rise or setting of certain stars, we are not to suppose that they seriously meant to ascribe such effects to the influence of those bodies. Geminus, an ancient Greek writer, (who probably flourished at least a century before the Christian æra,) expressly says, that it is altogether absurd to think that they have any power over the weather, and that such terms mean no more than, that the people, having by long observation found what weather most commonly took place at the seasons of the year which were distinguished by the rise and setting of particular stars, were thereby enabled to foretel what description of weather might be expected in future years, at the rise or setting of the same stars.

FEBRUARY.

Moon *new*, the 13th; *full*, the 28th.

The winds were generally moderate; the heat of the air was mostly temperate, sometimes tepid; and this state of the air often prevailed in the night, as well as in the day. The blowing and wet weather that did occur, took place more during the nights than the days. Some heavy dews were observed; and the lower strata of the atmosphere were several times charged with misty vapour, which twice condensed into drops, like rain from clouds. In this month also the south-west gales exceeded the north-west;

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stars. Since the observations, on which these prognostics were founded, must have been of a considerable number of years, it is thought that for the purpose they took the Metonic Cycle of nineteen years; for, as within that time the moon returns to the same aspects with the sun, and as that planet was believed to have a great ascendancy over the weather, they might imagine that an almanack of nineteen years would be a perpetual one, not only to mark the days of their sacrifices, and other solemnities, but also to predict the weather. Falconer's Collections on Natural History, page 53, 54.

west; and in these two months, the warm winds were to the cold in the ratio of 55 to 28.

MARCH.

Moon *new*, the 14th; *full*, the 30th.

Fresh breezes were frequent, and chiefly from the warmer points; the gales from south-west were nearly equal to the west and north-west. The rain, which sometimes was heavy, fell often in showers, whilst both wind and rain were greater in the course of the nights than of the days. The temperature of the air was cold till the 24th, and then it changed to so warm a state, that persons accustomed to wear great coats, laid them aside; no wonder, when Fahrenheit's thermometer rose to 61° in the shade.

APRIL.

Moon *new*, the 13th; *full*, the 28th.

Though there was a good deal of hail and some snow, yet the ground was so warm that they soon vanished. The general temperature of the month, indeed, was remarkably pleasant and genial; in the latter part of it there were several days in which scarce a cloud was seen in the horizon; the air was comfortably warm; and there being good moonlight, the nights as well as the days were quite delightful. The highest gales were from the north-west.

MAY.

Moon *new*, the 12th; *full*, the 28th.

The beginning of this month was equally dry with April; and between the two months there were 24 days, during which, hardly any rain fell. Not only was there an absence of rain, but the air was hygrometrically dry, as the instrument for ascertaining this, stood often at a drier point than it was observed to do for a considerable length of time before. The force of the winds was partly strong, partly moderate, and their direction generally was from the colder quarters, which made this month less genial than the preceding. The clouds appeared to be electrified in a much greater proportion, than what might have been supposed from the remoteness of the thunder and lightning that took place.

JUNE.

Moon *new*, the 11th; *full*, the 26th.

The winds were generally moderate in force, but proceeded from cold points, principally north. Though the sky was often covered, and indicated both rain and thunder, yet none of the latter, and comparatively little of the former happened; whilst a considerable degree of exsiccastion occurred in the air.

JULY.

Moon *new*, the 10th; *full*, the 25th.

The winds were more frequently moderate than otherwise; a good deal of rain fell; and both wind and rain were greater in the nights than in the days. Sometimes the weather was fair and the barometer high, though the wind came from the south. The sky was often extensively covered with common clouds, and several times it was streaked with plumous ones, whilst the air was frequently sultry.

AUGUST.

Moon *new*, the 9th; *full*, the 23d.

The wind was generally moderate, often easy, and advanced only to a few fresh breezes. The air was sometimes foggy; at other times a haziness appeared high in the atmosphere; again the sky was covered and lowering, yet frequently the sun shone bright. The weather for the most part was warm; in turns it was sultry; and taking the month in general, it was remarkably fine. A considerable quantity of silent lightning played throughout the atmosphere the 12th and 13th, in the evening and night.

SEPTEMBER.

Moon *new*, the 8th; *full*, the 22d.

There was some blowing weather, but in general the wind was moderate. Now and then the sky

SECT. III.

Agricultural Notices.

THE verdure of the fields, which was remarkable in the preceding December, continued equally striking throughout January; and in February the fields were still more verdant, and vegetation still more animated than in the former month.

The rain that fell in April was too little to promote vegetation in our soil, which is almost universally a pale yellow, or bluish meagre clay, considerably charged with gravel. This deficiency of rain was in some measure supplied by heavy dews which dropped every night. On the fruit trees, the blossoms were very luxuriant, and the whin or gorse was richly blooming. The foliage of trees and plants did not display so much energy as their opening buds did, which before the middle of the month wore so gay an appearance, that it might be denominated, in a term of the French calendar, *Floreal*, which corresponds with our 20th of April.

In the middle of May there was a good deal of hail; but being mixed with rain, it did not do so much injury to the gardens and fields as it would have done, had it been destitute of such modification. The dews in this month, as well as those in the preceding one, though not so heavy as in the warmer weather, were in some degree supplementary to rain in the process of vegetation.—However, the rain, which began to fall on the 8th, was of the utmost service to the vegetable functions, and gave a vigorous advancement to every kind of plant, whether in the field or the garden, which had suffered a check in the first week of the month.

Notwithstanding the considerable degree of arefaction which the atmosphere possessed in June, the corn crops were high and vigorous, covering entirely the sod since the latter part of May; the potatoes also promised well; but the flax, which was generally late, was not promising in its appearance, and a less quantity of seed was sown than the annual usage. The whole of July was favourable to vegetation.

The quantity of atmospheric electricity, which appeared the 12th and 13th of August, was observed to whiten both the barley and oats in a sudden and in a very considerable degree. Rank grain was lodged by the rain of the 16th, but not materially injured, as it was pretty ripe, and the air was very drying.

Harvest-home was accomplished before the squally weather of October; but even had it been otherwise, there were considerable fair and drying intervals, and in many of the days noted as showery, little more than a misty rain happened; from which circumstances it is plain, that had not the corn crops been well saved, the weather would not have been to blame. The flax suffered this season by what, in this country, is termed *firing on the foot*, which consists in reddish or brownish spots, dispersed chiefly over the reed of the plant, which is thereby more or less injured in the texture of its fibres. On this subject we shall treat more at large in the sequel.

Notwithstanding the rigorous weather in December, the verdure of the fields was considerable, but not so bright and vigorous as that of the preceding winter.

CHAPTER II.

Observations on the Weather, in the Year 1802.

SECT. I.

TABLE I.

Summary result of Meteoric Instruments.

Months.	Barometer.		Thermometer.		Hygrometer. De Luc.		Rain-Gauge
	Max.	Min.	Max.	Min.	Max.	Min.	Inch. Parts.
January	30.31	29.24	42½	25	41	38	2.758682
February	30.35	28.70	49	34	40¾	39½	4.427022
March	30.53	29.2	55	36½	40	36¾	2.364585
April	30.37	29.65	56	43	38½	32½	3.362939
May	30.49	29.53	66½	38½	35½	26½	1.261112
June	30.41	29.22	66	56	32¼	29¼	3.047661
July	30.28	29.19	59½	54	32½	27½	2.719253
August	30.25	29.51	71½	54½	37½	39⅔	3.389238
September	30.13	29.17	63½	52½	36½	33	3.468058
October	30.37	29.10	54½	41½	39	37	3.625697
November	30.15	28.92	50½	37½	39½	36½	0.630556
December	30.34	29.3	49	34½	40¼	38⅓	5.2020
Yearly	Mean 29.63+		Mean 48.81+		Mean 35.80—		Total 36.256801

TABLE II.

Numerical Direction of the Winds.

Months	N.	S.	E.	W.	N. W.	N. E.	S. W.	S. E.
January	6	8	5	7	6	3	7	4
February	4	2	0	12	8	1	5	3
March	1	0	1	23	8	0	3	0
April	3	0	0	21	5	1	4	1
May	5	8	6	3	10	2	0	2
June	2	1	0	15	8	0	11	0
July	7	2	0	2	19	1	9	3
August	2	11	1	9	4	0	11	0
September	2	7	1	6	5	0	11	2
October	1	6	2	13	7	0	7	2
November	2	11	14	0	0	5	2	8
December	2	2	3	13	3	3	4	10
Total -	37	58	33	124	93	16	74	35

TABLE

TABLE III.

Synoptical View of common Phenomena.

Months	Fair	Showery	Wet	Hail	Snow	Frost	Thunder & Lightning
January	13	17	1	1	6	14	0
February	10	17	1	3	7	9	0
March	10	21	0	9	7	3	0
April	4	25	1	5	2	0	0
May	15	16	0	4	3	1	0
June	5	20	5	0	0	0	1
July	2	29	0	1	0	0	0
August	8	18	5	0	0	0	1
September	10	19	1	3	0	0	0
October	7	22	2	2	0	0	2
November	22	8	0	0	0	6	0
December	7	18	6	2	4	9	0
Total -	113	230	22	30	29	42	4

SECT. II.

Miscellaneous Remarks.

" Maximus hic flexu sinuoso elabitur anguis
" Circum, perque duas in morem fluminis Arctos;
" Arctos, oceani metuentes æquore tingi.
" Illic, et perhibent, aut intempesta silet nox
" Semper, et obtenta densatur nocte tenebræ;
" Aut redit a nobis aurora, diemque reducit:
" Nosque ubi primus equis oriens afflavit anhelis,
" Illic sera rubens accendit lumina vesper.
" Hinc tempestates dubio prædiscere cœlo
" Possumus; hinc messisque diem, tempusque serendi;
" Et quando infidum remis impellere marmor
" Conveniat; quando armatas deducere classes,
" Aut tempestivam silvis evertere pinum.*

Virgil Georg. I. l. 244.

JANUARY.

Moon new, the 4th; *full*, the 18th.

[illegible] frequently: but there were only six days [illegible] freezing, yet the congelation was [illegible] the river Foyle, where it is above [illegible] was covered with ice: the keenest freezing

[illegible] the spiry dragon glides,
[illegible] stream the bears divides;
[illegible] by fate's decree
[illegible] southern sea:
[illegible] night is found
[illegible] ppy ground:

Or

freezing was during the night of the 14th, with the wind north and north-west. The snow was slight, not more than three inches deep; and a complete thaw, with little rain, took place on the 16th. The winds, in general, were boisterous; and in the night of the 20th and morning of the 21st, a tremendous storm raged from north-west; at one period of it the wind was supposed to veer to the south; from which point, indeed, it blew oftener throughout the month than from any other taken singly. As to temperature, after the 21st the air was remarkably mild.

The hurricane did considerable damage in the city of Derry and its neighbourhood. Several chimnies were blown down, or greatly injured; large trees were forced out of the ground; ships were driven from their moorings in the harbour; some of the railings of the bridge were broken; deal boards were blown off their piles; slates were wafted across broad streets, by which many windows were shattered; and a considerable stone, at the summit of the

Or when Aurora leaves our northern sphere
She lights the downward heaven, and rises there:
And when on us she breathes the living light,
Red vesper kindles there the tapers of the night.
From hence uncertain seasons we may know;
And when to reap the grain, and when to sow:
Or when to thin the woods of pine; when meet
To spread the flying canvas for the fleet.

This version is somewhat altered from Dryden, who translates, "*sylvis evertere pinum*," "to fell the furzes," whereas to me it appears, that the sense and spirit of the original are better expressed by writing, "to thin the woods of pine."

the former spire of the Cathedral, was displaced by the vibration of the spindle that supported the vane. But what appeared more extraordinary than all, was, that a vast sheet of lead, computed to weigh 8 cwt., was whirled off one of the vallies in the roof of the Presbyterian Meeting-house, and carried by the wind over one back-yard into a second yard adjoining it. Notwithstanding the falling of chimnies, the flying of slates, &c. no lives were lost, and little or no personal hurt was suffered.

The storm began two days after full moon; its increase commenced nearly at the moon's southing; and it was accompanied with heavy rain, mixed with snow and hail. The morning of the 21st the barometer was 29.24; thermometer 41½°; hygrometer 40½.

On the 31st likewise there was a violent gale, but it did not amount to such a rank storm as the preceding; it was noisy, not dense; and on land it did little damage.

FEBRUARY.

Moon *new*, the 2d; *full*, the 17th.

High winds were frequent; on the 3d, at night, there was a stormy gale from the south-west, touching sometimes on the east, accompanied with rain and snow; and, in the blowing weather throughout the month, the wind was oftener from the south-west than from any other point. Though there was a good deal of southerly winds, the temperature of the month was cold until the 17th, when it softened and continued so, even with squally gales.

MARCH.

Moon *new*, the 4th; *full*, the 19th.

Although there was a great majority of the winds due west, the weather was remarkably harsh and boisterous till the 23d, when "forth flew the tepid "airs," and thus, with only two interruptions, continued to the end of the month, the spring becoming very vivid. The highest winds were north-west and north north-west generally in squalls. The hail was not only frequent, but sometimes large. Two days it rained, though the barometer was at 30.18 and 30.43, and steady. The snow that fell whitened the mountains, but on the low lands, it immediately dissolved.

APRIL.

Moon *new*, the 2d; *full*, the 18th.

In general the month was rigorous as to rain, hail, and wind, yet there was some fine growing weather, and at the end vegetation was very forward: the hail was sometimes heavy; the winds were squally, principally at night; and on the 4th and 10th, there were severe gusts from the south-east and south-west. As to rain, this month fully maintained its character for being showery, which happened mostly at night. The snow was trifling.

MAY.

Moon *new*, the 2d; *full*, the 17th; again, *new*, 31st.

The weather was generally fair and bright, yet, with little exception, it was cold, until the evening of the 23d, when the temperature changed greatly, and became warm, advancing even to closeness. The winds were chiefly moderate, but sometimes squally from north-west, and sometimes blowing fresh from south and south-east. The snow that fell, on the 15th, whitened the ground, but it quickly melted; and the congelation that took place on the same day, early in the morning, was slight. In the beginning of the month, the winds were sharp; toward the close, they were dry and hot, contributing to the general temperature already noted.*

JUNE.

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* At London, the changes of temperature, in May 1802, were observed to be more remarkable than was remembered, in that season of the year, by the oldest man alive. During three successive days there were repeated falls of hail and snow in the city, and, at some distance from it, the ground was frequently covered; on these mornings, the frost was uncommonly severe, the ice being more than a quarter of an inch thick; after sun-rise, on the 16th, the mercury in Fahrenheit's thermometer was at 29°; and at a few minutes past 4 o'clock p. m. on the 18th, it was actually at 25°, or 7 degrees below the freezing point; a degree of cold which was thought to be unparalleled in England on the 18th of May. On the same day of the month, in the year 1794, pease were sold, in London, at 18d. a peck; a proof of extraordinary difference between that season, in 1794, and in 1802.

Although there was a considerable change of temperature at
ry in May, the cold was not so great as it was at
or the thermometer was not observed to be lower in
place than 38½°, which is 13½° warmer than it was in
the

JUNE.

Moon *full*, 15th; *new*, the 30th.

The winds were generally moderate; sometimes blowing fresh from south-west, as well as from the west and north-west. The rain was frequent, and at times heavy.

JULY.

Moon *full*, 15th; *new*, 29th.

The characteristic traits of this month were frequent showers, fresh breezes, and coldness. Nor did this state of temperature ameliorate in any degree until the 27th, when the air grew milder even with a north-west wind. The capricious nature of the winds was fully verified this month, being often south-west and north-west, again south and south-east, and sometimes south-east, north-east, and north-west in one day. Although the barometer was low the 21st and 22d, there was little rain, and there was a considerable arefactive power in the air, with the wind north-west and north.

AUGUST.

the latter. The weather, indeed, in every respect, is at all seasons more temperate in Ireland than in England; and therefore, since the climate of England is never adduced as a reason against the growth of trees there, why should the climate of Ireland be urged as an objection to their growth here, a country so favourable to the vegetable race? I expect it will be made appear in the sequel, that a proper system of culture will render plantations, in Ireland, perfectly adequate to repay the labours of the planter.

AUGUST.

Moon *full*, 13th; *new*, the 28th.

The winds were generally moderate, sometimes easy, and in turns brisk, especially from south and south-west. In the beginning of the month, the weather was warm; in the middle, it was sultry; and from the 28th, when there was an eclipse of the sun, it was fair and bright to the end.

It was fair with the barometer as low as 29.76; but the wind was south, and with this art of wind, especially when there is a fresh breeze, rain is not so much to be apprehended in summer, as when the barometer is equally low with any other wind in winter. Nor even when the barometer is high, with a west-wind, or toward the north itself, is there so good a prospect of fair weather, as with the above station and a south wind; for this very month, it was showery when the barometer was at 30.14 with the wind west and north north-west.

This was rather a wet month; most rain fell during the nights, and early in the mornings, especially in the sultry weather. The south and south-west gales were to the north and north-west as 4 to 2.

SEPTEMBER.

Moon *full*, 11th; *new*, the 26th.

There were several high gales of wind, not only from the north-west, but also from the south, south-west, and south-east; the latter three were in proportion to the former as 10 to 4, and greater likewise in force. The rain fell chiefly in heavy showers; there were also some heavy dews, a few fogs, and four or five mornings of hoar frost. The air, mostly after the 12th, was frequently warm, sometimes close even at night; and the sky was often so bright that not a cloud was to be seen.

OCTOBER.

Moon *full*, the 11th; *new*, the 26th.

The winds for the most part were moderate, and the chief gales were from the south and south-west; from which points and from the south-east the winds were to those from west and north-west in the ratio of 7 to 5. In the night of the 4th began thunder and lightning, which continued several hours; some peals were very loud, and some flashes very vivid, attended with considerable squalls of wind from the north-west, together with heavy rain and hail. Early in the night of the 22d also, there was a good deal of lightning, but no thunder; the wind was west, and accompanied with showers. A few days in the beginning of the month, the temperature of the air was warm; near the end, it was mild; and in the intermediate space, it was cold. The barometer, with the south and south-east winds, was low, yet the weather was fair; whilst at other times a good deal of rain fell in frequent and heavy showers.

NOVEMBER.

Moon *full*, the 9th; *new*, the 25th.

In general the winds were very moderate, only three or four smart gales the whole month, and these were from the north-east, south-east, and south-west. The due east winds, and those with an easterly bias, amounted to 27; from other points to 15 only. Little rain fell; but there was a good deal of foggy and hazy weather. Several days, the clouds apparently indicated snow, but did not discharge any, and they dissipated in moderate rain. The temperature of the air was sometimes very variable, being in one part of the day warm with a southerly breeze, and again cold with an easterly blast. The barometer was low five or six days with north-east, east, and south-east winds, and fair weather; even with the barometer 28.92, and a south wind; there was comparatively little rain.

DECEMBER.

Moon *full*, the 9th; *new*, the 24th.

There were eight strong and squally gales from south-east and north-east, and only two from the north-west; all the rest of the month the winds were generally moderate, sometimes easy. The numerical proportion of the westerly to the easterly winds was, as 20 to 16; which was a near approximation,

imation, considering that it was a season of the year, wherein it is unusual for the latter to occur so often; but from whatever quarter the winds came, they were severest at night. The rain was frequent and heavy; and, like the winds, it was worst during the night. The three first days, 10 lbs. of rain fell; which was succeeded by several inundations, that did a good deal of damage in different parts of the kingdom. There were five days of smart frost, yet it was not penetrating; the beginning of some of the nights was remarkably mild; and rain was at times interposed: nor was there much snow; so that this portion of the winter might be accounted open.

SECT. III.

Agricultural Notices.

THE storm, in January, did great injury to the verdure of the fields, which were considerably browner and more russeted after it, than they were subsequent to the thaw that took place four days before it. And it was remarked, that, under the snow, the greenness was less bright, than it is wont to be in an open mild winter, with the surface bare of the snowy covering.

After the middle of May some seasonable rain fell, which greatly refreshed vegetation. The early potatoes, whose leaves had been parched by the winds, and the corn, whose blades had been whitened a little by the same cause, were both greatly restored.

Though, in June, verdure and vegetation were for the most part strong, the crops of corn, in July, were rather thin, short, and backward; the season was very unfavourable to hay and turf, but the flax looked well.

The hot and close days in August were reckoned good filling weather by the farmers. In the vicinage of Derry, oats began to whiten the 21st; the barley harvest began the 26th; and pulling the flax commenced the 7th.

Even when showery, in September, the intervals were so long, the breezes so fresh, and the weather so filling, that attentive farmers might very well reap their ripe grain, which was the case with oats in a remote mountainous district the 17th.*

Between the showers, in October, there was great arefaction in the atmosphere, and harvest-works might be very well performed. In the neighbourhood of Derry, all the grain was in the stack-yards again the 24th. In respect to bulk, the crops of grain were considered ample, but the farmers reckoned the pickle or kernel rather soft.

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* At a gentleman's seat, several miles north-west of Derry, the 24th of September, the thermometer, in the shade, half after two o'clock P. M. was at 65°; in the sun, half after one o'clock, it was at 86°; in the green-house, shaded, at noon, it was 78°. Here vines yielded plenty and well-flavoured grapes, both black and white.

However, the grain was got in safely, so safely that I did not hear of any being spoiled, nor of a stack requiring to be opened after having been built in the haggard. The flax was a full crop, and of a good quality, little or no *firing* having occurred, though the season was so wet.

The potatoes were not so abundant and dry as they were in the year 1801; but being spared in the early part of the season, on account of that year's store, and the weather for digging them, in November, being so favourable, they were got in dry, which made them keep better than there was reason to expect from the wetness of the weather during their growth, and thus were they rendered sufficient for the consumption of the country. Although there was some smart congelation in November, yet it did not penetrate into the ground so as to injure these crops.

SECT. IV.

Cursory Remarks on the Origin and Nature of Winds.

BY reflecting on the above-mentioned storm, in January, we are led to muse on the causes of those impetuous movements of the atmosphere; and we are at first interested in the awful sublimity of the phenomena which took place, when the raging elements thus break loose. Notwithstanding the tremendous impressions and disastrous scenes produced by those elementary tumults, the admirers of nature feel something exalting in the

"Mighty tempest, and the hoary waste
"Abrupt and deep, stretch'd o'er the buried earth."

That legitimate child of nature, the ingenious Burns, was always enraptured when walking in the sheltered side of a wood or high plantation in a cloudy winter day, and hearing the stormy wind howling among the trees, and raving over the plain; it was his best season for devotion: his mind was wrapt up in a kind of enthusiasm to HIM, who, in the elevated phraseology of the Hebrew bard, "walks on the wings of the wind."

According to Lord Verulam, improved by Halley, the immediate causes of the motions of the atmosphere, or, in other words, of the ærial currents we call winds, are the expansion of air by heat, and the contraction of it by cold. This may be exemplified by the familiar instance of the tendency, which two masses of air of different temperatures, and consequently of different densities, in two contiguous rooms, will ever have to restore their equilibrium through any communication between them; the heavier portion moving in the lower part from the colder to the warmer room, while the more rarified and lighter will proceed in a contrary direction along the upper part; an intermediate space between these two opposite currents being left, where the densities of the two masses of air being uniform, they will of course remain quiescent.

In order to apply the same principle to account for various phenomena, which cannot be ascribed to the agency of what are strictly denominated winds, it has been observed, that this tendency in the air, to restore its equilibrium will produce currents, not only horizontal or inclined, but also perpendicular, both ascending and descending, according as the condensation or rarefaction takes place in different strata of the atmosphere.

The same principle is likewise employed to explain the winds which prevail on the opposite coasts of the Atlantic, between the tropics. The west coast of Africa, from Cape de Verd (14.45 north) to two or three degrees south, is said to be generally flat, with a sandy soil; hence that part of it, which is situated near the equator, must be excessively hot at all seasons of the year, and particularly so about the equinoxes. Within many leagues of this coast, then, the sea, during nearly ten months of the year, being much cooler than the land, the current of air, to restore the equilibrium, must necessarily come almost always from the westward, according to the situation of the sun, and the bearings of the land; but very seldom will it vary much from the western point near this coast, except at the two solstices. During the Harmittan,* and sometimes

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* The Harmittan is a kind of monsoon which prevails on the western coast of Africa, while the sun is near the northern tropic.

sometimes at other seasons, the wind will occasionally blow off the land for a few hours before day. On the opposite coast of America, for the same reason, the wind blows constantly toward the east, varying perhaps a few degrees north and south, according to the nature and situation of the neighbouring coast, and also in proportion to the sun's place in the ecliptic.*

Perhaps a more general cause of the winds may be derived from the laws of attraction or gravity, operating on the properties of our atmosphere; for it must be admitted, that the great body of air which invests our earth, is liable to be affected by the same physical causes which produce the flux and reflux of the sea. The question then will not be the existence of those atmospherical tides, but merely respecting their extent, which, doubtless, is greater than that of the ocean. For we have good grounds, both from theory and experience, to believe that the causes which excite the movements of the waters of the ocean, can occasion a much greater in the ærial mass of the atmosphere, and must have a very considerable share in producing the regular winds, as well as other phenomena that depend on them.

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* Capper on the Winds and Monsoons. In the effect here ascribed by Colonel Capper to the Harmittan, there is some difference from that assigned to it by Dr. Dobson, who says, (Phil. Trans. Vol. 71.), that the land or eaſterly wind is much more prevalent on the coast of Africa, during the period of that monsoon, than is admitted by the Colonel.

Hence it is plain, that nothing more is necessary than to deduce the appearances and extent of those ærial tides from the well known properties of elastic fluids; for which purpose we must have before us the principles of *Ærometry*, to be found in most elementary books. This is not the place for going formally into the demonstration; but I shall, in a summary way, observe, that according to those principles, every thing which increases the weight of the atmosphere, and presses the air more in one place than in another near that place, must cause the air to rush from the former to the latter where it is lighter: and, on the other hand, every thing that lessens the gravity of the atmosphere, and augments the volume of air or rarifies it, making it lighter than the neighbouring parts, must occasion the air to rush in from all sides to those parts; which effect continues, in each case, till the equilibrium be restored, and rest again take place.*

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* Philosophical Magazine, Vol. V. p. 105, 113.

A planetary influence on the atmosphere is maintained by several modern observers of accuracy and science. M. Toaldo, from observations made at Padua, during the course of 50 years, infers that divers revolutions and situations of the moon occasion various states of the atmosphere, and that a combination of some of those situations produces storms, tempests, hurricanes, &c. He coincides in opinion with Virgil, relative to the prophetic character of the fourth day before new and full moon. Mr. Howard made observations about five miles east of London, and from them concludes, that the atmosphere is subject to a periodical change of gravity from the attractions of the moon, which at certain times are modified by the joint attractions of the sun; but, that the difference between the physical properties of air and water, prevents

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29.24 to 29.61; and on the day of the highest wind, it was not less than 29.60. The thermometer was from 11° to 27°; on the stormiest day it was 25°. It is observable, that the barometer, at Londonderry, on the morning of the storm, at nine o'clock, was 29. 24.

The causes and progress of the north-east storms, in America, were several years ago traced by the late Doctor Franklin, who observed that they began first, in point of time, in the south-west parts of that continent. Hence he formed an idea of their cause, which he explained by two familiar instances. The first is, the flux of water through the lock of a canal, when the gate is opened. In this case, all the water moves indeed toward the gate, but the successive times of beginning motion are the contrary way, viz. from the gate backward to the next lock, or toward the head of the canal. The second instance is, the motion of the air in a room toward a fire burning in a chimney: the air in the chimney, being rarified by the fire, rises; the air next the chimney flows in to supply its place, moving toward the chimney; and, in consequence, the rest of the air successively, quite back to the door of the room. He does not, however, suppose that all storms are generated in the same manner. The north-west thunder-gusts, in America, were not thus produced, as he found by observation. It cannot, therefore, be assumed as a general and fundamental principle, that winds *always* originate at the extremity of that point toward hey proceed.

Although some valid principles are obtained, and considerable advances made in attaining a theory of the winds, yet observations must be extended to procure materials for rendering the system more complete and satisfactory. Until this is done, we may adopt the sentiment of Thomson, who personifies those furious sons of the atmosphere, called storms, and asks them,

"In what far distant region of the sky,
"Hush'd in deep silence, sleep ye when 'tis calm?"

CHAPTER III.

Sect. I.

On the Climate of Ireland.

THAT the climate of Ireland has suffered a considerable change, almost within the memory of the present generation, is not only a popular opinion, but is a doctrine held by intelligent and philosophical observers. We are told, that the winters, in this island, have laid aside their ancient horrors, and frequently assume the mildness and vegetative powers of spring; while summer is represented as less favourable than formerly, less genial in promoting vegetation, and less vigorous in advancing to maturity the fruits of the earth.

In support of these sentiments it is alleged, that our prevailing winds, which blow from the westward, have, of late years, swept with uncommon violence over the surface of our island; frustrating the usual effects of their genial properties, by the overbearing fury of their course. The evidences which are brought to prove this disposition of the winds with us, are three phenomena, stated as principally occurring in the province of Ulster, namely, the *trees* of the country, the *sands* of the sea-coast, and the *tides* of the ocean.*

In order to try the merits of this doctrine, it seems necessary to attempt tracing the climate of Ireland from the earliest period, of which we can have any credible information, until the present time; an undertaking, it is true, accompanied with considerable difficulty, in as much as a regular series of documents on the subject are not obtainable. But the documents employed, however scanty they may be, shall be those that appear most authentic; and where defective links occasion breaches in the chain, they will be repaired by such reasons as the next adjoining data on each side, or the principles of analogy, shall warrant. Thus regulated, the inquiry, if not complete in all its parts, will be sufficient to determine the question before us, and will serve as an elementary outline to be filled up in future.

There is good reason to believe that Ireland is the hyperborean island, said to be *more northerly than the north wind*, as mentioned by Diodorus Siculus, the historian, who lived 45 years before Christ. Strabo, the geographer, whose life is dated a few years earlier, supposed this island to be so cold as to be scarcely habitable, and all beyond it to be of course absolutely unfit for human dwelling. On the other hand, the hyperborean island is represented as a very temperate region, and figuratively so fertile as to produce two harvests in a year. This latter character certainly answers to the general reputation of Ireland, in respect to the mildness of its climate, and to the comparative fertility of its soil; but the former one is a palpable mistake, and seems to arise from the ignorance of the Greeks in geography, during a series of ages after they had driven out the Pelasgi; of which tribe were the Irish Firbolgs, and the Dadanans, who afterward had intercourse with Greece.

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* Hamilton, Transact. R. I. A. Vol. VI. Science, page 27. A Memoir on the Climate of Ireland, read in 1794.

It appears that the Greeks knew more of our globe in the time of Homer, who lived above a thousand years before the Christian æra, than they did in the time of Herodotus, who lived above five hundred years after him; and, with reason it is supposed, that Homer had his knowledge from a Pelasgian, who was his master. Hence we may conclude, that, in very remote ages, Ireland was known and distinguished for the temperate nature of its air; and we have grounds to believe, that, thenceforward to the present day, the climate of this island is not materially altered, at least not in such measure as to enfeeble its natural faculty for fostering the growth of plants, from the herb of the field to the tree of the forest.*

The superior mildness of the climate of Britain over that of France, as stated by Julius Cæsar, is known to every school-boy ; and it is probable, that they were then pretty much on a par with respect to woods, wastes, and cultivated grounds, which influence the temperature of countries.[*] Buchanan, the classical historian, who flourished in the middle of the 16th century, quoting the remark of Cæsar, pronounces the climate of Ireland to be more mild than either that of Britain or of France. And, among the many causes which he assigns for the emigration of a colony from Spain to Ireland, before going to Britain, he reckons the genial nature of the climate and soil of this country a leading one.[†]

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* Collect. de Reb. Hibern. Vol. III. p. 110, 115, Preface. Id. Vol. IV. Preface, p. 27, 40, Id. Vol. IV. p. 28. Vallancey's Vindication, p. 14, 19, 21, 22, 501.

Orosius, the historian, who flourished in the beginning of the 4th century, speaking of Ireland, says, that it is nearer than Britain, and, though smaller, is more useful by reason of the moderation of its heat, and the mildness of its weather in general.[‡] Stanyhurst also, in the preface to his Irish chronicle, supports the representation given by Orosius, and further observes, that few countries are comparable, none preferable, to Ireland in wholesomeness of air, fertility of land, abundance of corn, extent of pasturage, and number of cattle.* Boate, who quotes these authorities, corroborates the sentiments which they express, and contends that there is no impediment, but the want of common culture, to prevent Ireland from being justly counted amongst the most fruitful countries in the world.†

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[*] "Loca sunt temperatiora quam in Gallia, remissioribus frigori-"bus." Comment. V. Bell. Gallic.

[‡] "Hibernicum autem solum amœnitate, et cœlum temperamenti "æquabilitate longe Britannicum superat——Verisimile autem non "est Hispanos relicta a tergo Hibernia terra propiore, et cœli, et soli "mitioris, in Albium primum descendisse, sed primum in Hiberniam "appulisse, atque inde in Britanniam colonos missos."
Rerum Scot. Hist. Georg. Buchanano, Lib. I. II.

[‡] "Hæc propior Britannicæ, spatio terrarum angustior, cœli so-"lisque temperie magis utilis."

The venerable and authentic Bede, who flourished about the end of the 7th century, says, Ireland is pleasantly situated, that it abounds with milk and honey, and that it is not destitute of vines.‡ Cambrensis, who was twice in Ireland, and who collected materials, toward the end of the 12th century, for a topography of this island, declares, that nature has looked with a more favourable eye than usual upon this kingdom of the zephyrs. At the same time, he contends that the climate is wet and windy, and represents the south-west wind as the most violent. This seeming contradiction may be reconciled by observing, that the frequency of our showers and fresh breezes gives an appearance of wetness and ventosity, whilst the mild temperature of our air softens the impressions of the rain and wind on the feelings, and entitles the climate to the genial character bestowed on it in the above general inference drawn by Cambrensis.

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* "Cum Hibernia, cœli salubritate, agrorum fertilitate, ubertate "frugum, pastionis magnitudine, aramentorum gregibus, conferre "paucas, anteferre nullus valeas."

† Natural History of Ireland, Chap. X. Sect. VII.

‡ "Hibernia dives lactis et mellis insula, nec vinearum expers."—"Insulæ hujus situs est amœnus."—Bede Hist. Gent. Anglican. Vita St. Columbi, Chap. I.

In Peter Lombard's time, above 180 years ago, the winters in Ireland, he informs us, were so mild and open, that the inhabitants were negligent in making hay to fodder their cattle, depending greatly for their support on the hibernal verdure of the country.* On this account it has been remarked, that probably it was not so much the mildness of our winters that made people neglect saving hay, as inattention to the stock, according to the ground they held. In Lombard's day, there were very few stall-fed cattle; those brought to market were not half fat; nor was that useful part of rural economy, farm-yards, dry housing, and dry fodder, then understood. A few fields of waste grass were sufficient, during the winter, for beasts always accustomed to exposure in the open air; and it is added, that both want of civilization and of industry prevented the natives from making other exertions. However just this comment may be on the indolence of the Irish, and their ignorance of husbandry at that period, it does not invalidate the testimony of Lombard, as to the matter of fact respecting the winter season, namely, that in general it was extremely temperate.

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* De Regno Hiberniæ, Sanctorum Insula, Commentarius, &c. page 85. His words are, " Hic plerique negligunt resecare fœnum ob summam temperiem æris." Lombard, same work, page 72, mentions the humidity of our climate, but that it might, in some measure, be corrected, as done in Flanders, by drains, and by clearing the course of rivers and streams. Boate makes a similar observation. Natural History of Ireland, Chap. XXI. Sect. VI. It is probable that Lombard's observations were made nearly thirty years prior to those of Boate, who writes of the prevalent west-winds thus: " It is worth " the observation, that not only storm-winds, but others also, do in " Ireland much seldomer blow out of the east, than out of the west, " espcially in the winter; so that commonly there is no need of a wind " to be wafted over to England: where to the contrary, thoſe, who " out of England will come over into Ireland, very ordinarily are " constrained to wait two or three weeks, and sometimes five or six " weeks, yea, it hath fallen out so more than once, that in two whole " months, and longer, there hath not been so much east wind, as to " carry ships out of England into Ireland."

The exact and indefatigable Dr. Rutty kept a journal of the weather, at Dublin, nearly half a century, viz. from 1716 to 1765, and after comparing the whole with the observations of different persons, made through all the varieties of the weather, he found a wonderful harmony between them. By a septenary table of the winds which he constructed, from the year 1759 to the year 1765, inclusive, it appears, that those from the westerly points were, to those without any point of the west, in the proportion of 1813 to 1281. In that table, the force of the winds is not stated; but, in looking over his journal, we find that the most frequent high gales were from west south-west and north-west, though the latter direction is noted as occurring, upon the whole, seldomer than the two former. The relative proportions at large are, west, 668; south-west, 688; north-west, 457.

Together with the warming influence which the predominance of these weasterly winds is calculated to exert, we have other proofs of the continuing mildness of our climate at that period. First, from the comparative annual heat between Dublin and London, which was found to be in the ratio of 12,07 to 12,00. Secondly, from the amount of the insensible perspiration in the human body, which was ascertained by statistical experiments to be greater in Dublin than in England, and in Cork almost equal to what it was in Italy.*

The winds of the winter preceding 1789, in Dublin, were mostly east; and on the night of the 13th December it blew a storm from east south-east with snow; afterward a storm at night from the east. Of thirteen storms and hard gales, in 1789, there were eight due west, one only north-west, and the remainder from other points. In the year 1790, the storms from the south-west and south predominate in force as well as frequency, and those from the south occurred all in February. A great majority of the storms, in 1796, were from south-west, south south-east, and west. In 1797, there were twenty-four storms, only one of which was from north-west, and that was in participation with west; the residue being south-west; west; south; north, and north-east. Of twenty-seven storms in 1798, the north-west makes five; the remainder were from other

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* Rutty's History of the Weather, page 326, 329, &c. Id. Introduction, page XXXIX. XL. Rogers on epidemic diseases. Static. Experiments, page 203, 311. Dublin is in lat. 53° 21′, N. long. 6° 5′ W. Cork is in lat. 51° 53′ N. long. 8° 23′ W. The medium temperatur of the earth, in different parts of the city of Cork, as found in 1788, was from 52°,5 to 53°,5. Transact. R. I. A. Vol. I. II. Science, page 154—6. Dr. Hamilton (Memoir page 41.) acknowledges, that the annual sum of heat, received in Ireland, is not less, in our day, than it was in former ages; and, in page 49, he bears testimony to the equable distribution of heat in this country, whence he deduces the mild temperature of our seasons, and the perpetual verdure of our fields, unimpaired by either solstice.

quarters, among which the south and south-west predominated. The greatest number, out of forty-six storms, in 1800 and 1801, were west; south-west; south-east; and north; the fewest were north-west. Although the word, storms, is here used, it is not to be taken in its common acceptation throughout; but to be understood as comprehending high winds, fresh gales, and squalls.*

The medium atmospherical heat of five years, in Dublin, viz. 1794, 1796, 1797, 1799, and 1800, is 50° 15 plus; the max. is 81° 50; the min. 14° 50. The medium heat of the earth, in same city, as found by the temperature of the water in covered deep wells, in the year 1788, was from 50° to 52°. The thermometer, in January 1789, at eight o'clock A. M. stood at 17°, 5, in London; at 2 o'clock P. M. it rose to 24°, in Dublin it rose to 28°.

From a sketch of the weather, taken at Galway, in 1789, it appears that the north-west winds were most prevalent there from January to August; that the storms and squalls from north-west, and those from south-west and south, were on an equality in number;

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* Some of the storms, in January 1789, were at the same time and from the same points at London, as they were at Dublin, and a snow-storm occurred from the south-east. A storm on the 26th December, 1788, was felt equally in London as in Dublin. The snow in January, 1789, began six days earlier in London than in Dublin. In May there were three storms from south-west; in June were three storms, one from north-west, and two from south and south-west. The weather was more stormy at London in September and October, than it was in the *west* of Ireland. In December there were several storms from the west and south-west. Trans. R. I. A. Vol. V. Science, page 13, 15.

ber; and that the north-west and south-east winds sometimes alternized.*

At Belfast, in the year 1789, the weather was sometimes the same as in Dublin, and sometimes severer than in the latter place; there was a storm the 15th January from west or south-west; and in March, the easterly wind was squally, as it was in Dublin. There was a violent storm in June, but the direction of the wind is not mentioned; and after June, no more observations are related.†

At Derry, from 1791 to 1796, inclusive, there were many strong and squally gales from south-west and south-east, as well as from north-west; and upon comparing them, the former are to the latter in the proportion of 9 to 7. In the year 1799, the north-west wind prevailed only in May; and in the other months, the south-west, west, south-east, and east predominated in number and force. In 1802, the north-west wind was most frequent, whilst the south and south-west often exceeded the north-west in force, and sometimes there were high winds from the eastern points. Even in the hurricane of January, the

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* Galway is in lat. 53° 16′ N. long. 9° 12′. W.

† Belfast is in lat. 54°, 38′ N. long. 6° 30′ W. From observations, in 1796, this town appears colder than Derry. In that year the thermometer was max. 75° 50, min. 14° average, 44° 75′. There was much hail, snow, ice, and wind in June. Though the max. 71°, and the average 44 are less in Derry than in Belfast, yet, as the min. 17° is greater, the actual cold at Derry was less. In June, at Derry, though the weather was rather cold, yet there was neither frost nor snow, and hail occurred only twice. The max. of the thermometers was 69° and the min. was no lower than 49° 50′.

the wind was observed to veer to the southward of west. From January 1803 to February 1804, inclusive, the numerical proportion of north-west gales to those from other points is as 7 to 22, of which latter number ten are south-west, which often exceeded the north-west in force, also, especially in the case of the heavy gales, in January, and February 1784, by which so much damage was done at sea. In respect to numbers, the ratio of the winds, during nine years, viz. from 1795 to 1803, inclusive, is north 295, south 398, east 283, west 1005, north-west 737, north-east 265, south-west 599, south-east 454.*

Of sixteen terms, noted at Derry, from 1795 to 1802, inclusive, the mean heat is 49°, which corresponds with the highest medium temperature of the earth, in the same place, ascertained by experiment, in 1788. The max. of the sixteen terms is 81°; the min. is 17°.

Observations shew, that on the western side of our hemisphere, between latitude 47° and 60°, the *west* wind, with some participation of the *north* or *south*, is that which oftenest obtains. These tendencies proceed from causes of an original and permament nature, which in certain seasons and situations undergo temporary modifications, such, however, as do not radically alter the fundamental law. Hence may be explained the more frequent occurrrence of the north-west wind in the northerly parts of Ireland, than in the southerly parts, which appears in the preceding meteoric extracts. The difference in this respect might be supposed to indicate a change of climate in this country; but when it is considered, that Rutty's observations, and most probably those of Cambrensis, were made in the eastern and more southerly districts, not comprehending the north and north-west tracts, we have reason to conclude that the agency of the general law has all along operated, and of course that the climate is not essentially altered, in as far as the westerly winds are concerned.*

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* Transactions R. I. A. vol. II. Science, p. 154, 155, 156. Id. vol. V. Science, p. 1, 8, 9, 16, 19. Id. vol. VI. Science, p. 309, 435. Id. vol. VII. Science, p. 316, 357.

The opinion of Cambrensis with respect to the wetness of our climate, as well as in relation to its windiness, is adopted by Dr. Ledwich, on the authority of Dr. Rutty, who calls this country '*Matula Jovis.*' If by wetness or humidity be meant, that more rain falls in Ireland than in England, it is not confirmed by subsequent observations, which shew, as I elsewhere have stated,† that the contrary is the fact. The medium quantity of rain in Ireland, at large, is from 24 to 28 inches; whereas, in England, the average exceeds 51 inches. But if it be meant, that in Ireland a great number of rainy days occur than in England, in this sense the remark is admissible. Nevertheless, I cannot subscribe to a conclusion drawn by Dr. Ledwich, namely, that the fair days in Ireland do not exceed in number one third of the year.

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* It appears, indeed, that the information of Cambrensis, respecting the climate of Ireland was limited; we are assured that he had but an imperfect acquaintance with even a third part of the island, and that he had only two years to collect materials for his whole work; himſelf eighteen months, and his friend Verdon, ſix. Walsh's Prospect of the state of Ireland, Preface, p. 26. Edit. London, 1682.

† Derry Survey, page 15.

At Derry, in 12 years, from 1791 to 1802, inclusive, the medium number of fair days is above 126; max 148; min. 113. At Belfast, from nine years' observations it appears, that the medium number of fair days is also above 126; max. 161; min. 90.* The yearly number of fair days in Dublin, is from 168 to 205, and the middle number is 179. At Edgeworthstown, in the county of Longford, in the year 1798, there were 233 fair days. Taking twenty-three terms in Derry, Belfast, Dublin, and Edgeworthstown, from 1788 to 1802, the medium number is nearly 140; so that even the annual mean of fair days in the kingdom at large may be stated at nineteen above the third.

SECT. II.

On the Constitution of the Atlantic Ocean.

THIS extensive region of waters being denominated by Dr. Hamilton, "the vast and potent arbiter

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* This min. 90, may be supposed a mistake, since it does not rate in proportion with the max. and since it is 23 days fewer than the minimum observed at Derry, where probably as great a number of showery days happen as in any other part of Ireland.

"biter of our seasons," it is necessary to inquire into its nature, in order to discover in what it may contribute to shed light on the question before us, respecting the supposed change in the climate of Ireland.

Exclusive of the undulation caused by the winds, and that swell known by the name of tides, the sea has a third motion, or continual tendency toward the west. This motion begins on the west side of America, where it is moderate; and hence that part of the ocean is denominated *Pacific*. As the waters advance westward, their motion is accelerated; and, at the Cape of Good Hope, the current often runs rapidly, even against strong westerly storms.

From the Cape to the island of St. Helena, there is always a current, which is one reason why that island is often passed or overshot in the night. In this track the waters of the Indian ocean find their way into the Atlantic, and flowing from the coast of Africa toward America, where being intercepted in their course, that part of the body which is to the southward of Cape St. Augustine in Brazil, is divided by this most eastern point of America; whilst that part, which is to the south of this, proceeds along the eastern coast of South America, and even through the Straits of Magellan, into the South Sea, and probably past Cape Horn. But that part of the Atlantic current, which is northward of Cape St. Augustine, is totally intercepted by the American continent, whereby it shapes its course toward the Gulf of Mexico, in which it is accumulated, by the North American continent, stopping its progress to the north-west, and the trade wind behind forcing it forward.

The direction of the western coast of Africa also would seem to give to the current of the Atlantic an impulse toward the Gulf of Mexico, where, being pent up, it has no other way to escape, except past Cape Florida, between which and the island of Cuba it forces its way; and having passed this Cape, it bends its course to the northward, between Florida and the Bahama islands. From this it flows to the northward, along the southern shores of the United States; whence it takes a north-east direction, until it vanishes about latitude 42 or 44 degrees north, toward the banks of Newfoundland.*

The breadth of the stream varies in its course; on the coast of Africa it is about 140 or 150 leagues; at other parts about 10 leagues; and when it comes out of the Gulf of Florida, it is about 8 leagues broad. Although the Gulf-stream runs in some of its most rapid parts, between the Bahama islands and Florida, from two to three miles an hour, to the northward of that strait it runs slower.

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* There are some exceptions to the general direction of the current of the gulf-stream; these are, the lateral diverging partial currents, and somewhat of a lee-current. There is also a current which sets southerly, along the coasts of Greenland and Labradore, from Davis's and Hudson's straits, &c. which meets the gulf-current, and, intercepting each other, they probably accumulate the substance which subsists the immense numbers of fish that frequent the banks of Newfoundland. These two currents, together with the cold wind from the north, commonly met with there in a very condensed body, may be reckoned the causes of the fogs which prevail on those banks.

This water, forcing its way from a warm to a colder climate, will carry much of its heat with it into the colder parts of the Atlantic, as has been satisfactorily proved by Sir Charles Blagden.* It preserves its superiority of temperature at least from latitude 25° to latitude 44°, which it reaches in 20 or 30 days; and it is supposed to retain about 4° of their heat again it arrives toward the western coasts of Ireland. Although a part of the stream, which is most southerly, and in which that substance called the Gulf-weed floats, returns again toward the south, and performs a circuitous regress into the Gulf; yet the far greatest part of it takes a different course, and is driven by the *west* winds toward the northern coasts of Europe. Of this we have a convincing proof from the seeds of vegetables, which are produced in the West Indies alone, being yearly found on the western coasts of Ireland, and on those of the western isles of Scotland.

The waters of this stream certainly have a great share in moderating the coldness of the European winters, but particularly in preserving the mild temperature of the Atlantic, which is clear of ice above 10 degrees farther toward the pole, than any other ocean or sea in the world. This state of temperature in the Atlantic may be further explained by observing, that this ocean keeps broad and bold, quite away to the north pole perhaps, or to 81° north latitude, as it has been explored so far by whale fishers; whereas the Pacific ocean is contracted, at about 66° north, to a narrow strait of 14 leagues between the continents of Asia and America. The west winds being rendered mild by passing over the great body of warm aqueous fluid in the Atlantic, and the waters being also perhaps augmented in their heat by the agitation they cause in the ocean, both come upon our islands, particularly Ireland, with considerable mildness. Hence these islands have the mildest winters of any; and next to them the continent of Europe, which is so mild as to be habitable to near 70° north, and to have fertile populous countries, with large cities, to above 60°.*

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* Blagden's observations on the gulf-stream were published in 1781; those of Franklin in 1786; and those of Pownal in 1787.

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* Dr. Franklin takes particular notice of the warmth of the gulf-stream, and the attention which its current deserves from navigators. Mr. Strickland advises the Atlantic ocean to be explored between the 47th and 60th degrees of north latitude, to ascertain the boundaries of the gulf-stream; for which purpose he recommends the thermometer. He also represents the utility of this instrument, not only in ascertaining the gulf-stream, but in finding out its northern eddy, so as to enable mariners to quicken the passage of ships from Europe to New York, and the south-wsstern ports of the United States. He is moreover inclined to think, that the thermometer may be useful in determining a ship's situation at sea. The quicksilver falls on approaching banks and shoals in so sensible a manner, that, on the same parallel of latitude, he observed a difference of 20 degrees between the temperature of the ocean out of soundings, and of that which covers the bank of Newfoundland. The mercury rises again when a ship sails from shallow

This mildness must proceed from the vicinity of those parts of Europe to the western breezes of the Atlantic. These winds hold on their course to Siberia, and all the northern country of Tartary. But China being on the very eastern side of the old continent, the west winds must pass over the continent of Europe and Asia, before they can reach China, and therefore are much cooled by the extensive frozen regions which they must cross, as this is the greatest body of land in the world. Hence the rigour must be proportionably increased, and consequently the east side of the old continent is so very cold, as to be scarce habitable to 50° north. Thus the countries northward of Korea and Kamschatka, and all along the east side of the continent, are colder in the winter than it is in similar latitudes in the eastern side of the new continent; for the empire of China is much colder than the same latitudes in the United States of America. At the city of Pekin, the cold of winter and the heat of summer exceed the temperature of those seasons in Philadelphia. In the same parallel, in the interior parts of the old continent, the cold and heat are both greater, where they may

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low to deeper water; circumstances which surely will aid the judgment in approaching shoals or in receding from them. He makes the temperature of the ocean, off the Grand Bank, to be 68 degrees, that of the neighbouring gulf-stream, 72 degrees, and that of the water on the Grand Bank to be 52 degrees of Fahrenheit's thermometer. American Philosophical Transactions, Vol. V. anno 1802. This proposal of Mr. Strickland's, may turn out to be a good auxiliary in navigation, and be employed in addition to the log, the lead, and the quadrant for conducting vessels through the pathless tracts of the ocean.

may be less influenced by its sea and its temperature; nay in lower parallels of the old continent, the cold is greater than in higher ones of the new. The winters are as cold at Canton, lat. 23° 20′ as at Charles-town, lat. 32° 45′.*

This may be further illustrated by observing, that the western coasts of all continents and large islands, in the temperate zones, have a higher mean temperature than the eastern coasts under the same parallels, and in particular have more moderate winters. The general current of air from the equator, when it arrives in the northern temperate zone, is south-west; this current, coming from the sea to the western coast of each continent, will there meet with cold air, which condenses its vapour as it proceeds, affording plenteous rain and heat to the western coasts. As this south-west current advances into the internal parts of the continents it loses its vapour and heat, till the deposition from it becomes much less in quantity, and appears in the form of snow; the current then continues its progress, and grows colder and colder until it arrive at the eastern coast, unless the influx of sea breezes mitigate its rigour near that coast.†

SECT.

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* Philosophical Transactions, 1781. Encyclop. Brit. Article, Sea. American Phil. Trans. Vol. II. 1786. Pownell's Hydraulic and Nautical Observations, 1787. Barnwell's Physical Investigations and Deductions, edit. Philadelphia, 1802.

† Dalton's Meteorological Observations and Essays. Ess. II. and V.

SECT. III.

On the Tides affecting the Coasts of Ireland.[*]

On the western coasts of Ireland, Spain, and Portugal, it is high water about the third hour after the moon has passed the meridian; thence the tide flows into the adjacent channels as it finds the easiest passage. One current, for example, runs by the south of Ireland and of England, and another by the north of Ireland and of Scotland. These currents will be at the several places to which they tend, in a space of time proportionable to the respective distances they have to run, and the waters will rise according to the shoals, the width of the channels, bays, or creeks, the flatness of the shores, and the like circumstances. On the west and north-west coasts of Ireland, the flood tide comes from the west, and high tides, as has been observed above 150 years ago, flow upon all these coasts, not only along the open shores, but also within the bays and estuaries, even those which penetrate a considerable way into the land.[†]

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[*] Though this branch of the subject be not the next in order for discussion, yet, since it is so nearly allied to the contents of the preceding Section, a two-fold advantage arises from introducing it here, that is, mutual support and illustration derivable from proximity.

[†] Philosophical Magazine, Vol. VIII. page 139. Boate's Natural History, Chap. VI.

monies on the part of Dr. Hamilton, seems to proceed from causes of too petty and vague a nature to be taken into account on such an occasion. Those consequences, in fact, are generally produced by the reiterated action of common winds and tides, on works in the main defectively executed in this country.

Instead of the sea having, of late years, encroached upon the land, observations shew that the contrary is the case, and that it is gradually retreating below its ancient level. All the flats of Magilligan, in the county of Derry, were submarine, at no very remote epocha, as testified by the abundance of shells in dry sand, two miles from the shore. Instances of a like description are found in many other countries; in England, Holland, Flanders, France, Spain, Italy, Greece, Egypt, India, Mexico, &c. This gradual declension of the sea accounts better for the damage done to several ancient harbours, whose channels were not deep, than by saying that the sea advances in some places and falls back in others, an idea quite contrary to the laws of hydrostaticks.* Repeated influxes of the sea, without any uncommon perturbation, doubtless may throw up mounds of sand on a flat shore, and make breaches in parts of a coast; but its general level will be uniform. Nor do submarine peat-grounds, and forests, observed on the coasts of Ireland and England, furnish any arguments against the slow recession of the sea; for there is good reason to believe, that those phenomena are caused by a subsidence of the lands, not by an elevation of the waters.*

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* Statistical Survey of Derry, p. 425. Letters from the Rev. R. Dr. Nicholson, the antiquary, in the year 1725. Letter I

Not only in the climate of Ireland, but in that of many other countries throughout the world, changes are supposed to have taken place, and to be specially manifest in latter times.† But upon careful examination, I suspect that it would be found, that this conclusion is not supported by sufficient evidences. We shall here take, for instance, the climate of Italy, and the neighbouring countries, whose history, ancient and modern, is better

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* Wrecks and wastes of the land, occasioned by rains, floods, cataracts, and rivers, contribute to restrain the influxes of the ocean, and to limit its boundaries in certain places; which in some countries occur in a remarkable degree. The river Mississippi has enlarged the American continent between two and three hundred miles. Not a single stone, even the size or nature of a pebble, is to be found in the whole course from the Ibberville to the entrance. The structure of this new ground is thus explained: The shores of that river, and of its great tributary streams, are lined with innumerable trees, which are wafted and constantly float down the current; making an appearance not unlike an immense mast and spar-yard. The trees are very large, and, on reaching the mouth of the river, are driven ashore by the winds and tides; some are carried out to sea, and are to be met with a great distance from land. These trees accumulating, become a mound, which arrests the muddy sediment of the river, and, in process of time, form numerous small islands which, constantly increasing and uniting, at length constitute part of the continent. This fresh land is first covered with bulrushes; then with bushes resembling alders; and, lastly, with ash and other forest trees.

† Phil. Magazine, Vol. IV. p. 337, 347. Vol. V. p. 18, 23.

known than that of any other foreign country with which we are acquainted.

The winter in those countries, in the present age, as it was in former times, is generally introduced with thunder and lightning; and the season is often very cold and frosty. Mr. Gray, in 1739, admired the beauty of Lombardy, but had to regret that it was deformed by the severity of the winter. Toward the end of January, 1770, Brydone observed Fahrenheit's thermometer, at Rome, as low as 27°. In 1781, Dr. Pugh found the winter at Naples extremely rigorous; three nights sharp frost, in the month of January, killed all the orange, lemon, pomegranate, and other tender trees in the environs of the city, and did more damage than a long succession of the mildest winters could repair.

Brydone assures us, that the spring is no better comparatively than the winter; which was also the case in pristine times, when the weather was wet and windy, with hail even in April. It was, indeed, he remarks, abundantly warm, at Naples, in May, but seldom a day passed without sudden storms of wind and rain; which brings to mind the 'Madidum ver' of Juvenal. From a comparative view of the state of vegetation in ancient and modern times, it appears that the budding and leafing of trees, together with the flowering of plants, were at least as early in the former when the seasons were supposed to be colder, than in the latter periods when they are alleged to be warmer. Formerly the hay, barley,

barley and wheat-harvest, began in June and ended in July; latterly, wheat-harvest commences in the end of May, and terminates in the end of July.

At present, as it did in days of old, the hot weather begins in May; and throughout the summer it was, as it still is, scorching hot, so hot as to burn up the grass, and to be scarce supportable by human feelings,—an intemperature which Virgil calls '*torrida æstus.*' The weather at Venice for the year 1755, mentions two whirlwinds, and a violent storm resembling that described by Virgil, Georg. I. 316, which he had often seen in the corn-harvest. Upon the whole, the Italian climate in recent years displays the same cold frosty air, the same piercing, changeable high winds, and the same sultry suns that it did in very remote ages.*

Still less reason is there to suppose that a change, in any material degree, has of late years obtained in the climate of Ireland; because its temperature in heat, which radically governs the other atmospheric conditions, has been uniformly moderate throughout all ages; because its *general* surface is only 270 feet above the sea; because the altitude of its highest mountains is comparatively low; and because its

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* Varro, who flourished 72 years *before* the birth of Christ; Virgil, 50 years; Horace, same time; Ovid, 10 years; Columella, 43 years *after* Christ; Pliny, the elder, 74 years; Juvenal, 100 years. Gray's Works by Mason, Letter XIIIth, XXth. Brydone's Tour, Letter Ist. Pugh on the Climate of Naples, Rome, and Nice. Symonds on the Annals of Agriculture, Vol. IV. Falconer's Tracts and Collections, p. 73, 5.

its geographical situation is far advanced westerly into the Atlantic, *the vast and potent arbiter of our seasons.*[*]

Dr. Hamilton, indeed, confesses that there is no clear evidence from meteoric observations, that the passing seasons are materially changed in comparison with those of more remote years; " and therefore " philosophers and meteorologists naturally (I would " add, *justly*) ascribe to the querulous disposition of " the farmer, the chill sensations of old age, or the " predilection which every one feels for the cheerful " days of childhood, the adoption of an opinion that " seems so easily to flow from these sources.[†]

At the same time, in order to prop a favourite structure, built with such slight materials and upon so sandy a foundation, as the tides of man's temper and the gusts of human sensations, than which the constitutions of the atmosphere, in their most fickle moods, are not more uncertain;—in order, I say, to sustain so infirm an edifice, he has recourse to the insufficiency of the instruments for atmospherical investigations, and the omissions of observers with respect to several phenomena.

I am ready to admit, that the meteoric instruments, now in use, are not perfectly competent to ascertain, with strict philosophical accuracy, the several conditions of the air, which influence the crops of the farmer, or the sensations of the man;

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[*] Transact. R. I. Academy, Vol. VIII. Science, p. 261.

[†] Hamilton's Memoir, p. 27, 28.

and I am equally ready to admit, that "heat and "cold, and rains, are indeed principals in the economy of seasons; but winds, clouds, vapours, and "other circumstances, rarely registered often unperceived, are to be deemed at least ancillary in the "system; and may give *plausibility* to popular sensations and opinions, even without the aid of meteorological testimony."

But whilst I acknowledge the imperfection of meteoric instruments, and accede, in a certain degree, to omissions on the part of observers, I cannot grant that deficiencies in either, or in both, justify the charges laid against the climate of Ireland, setting forth its hostility to the growth and maturity of trees, until it shall be proved that the defects of the barometer, thermometer, and other similar instruments, combined with ignorance of the laws of rain, winds, clouds, vapours, &c. are principal and direct impediments to vegetation and arborescence in this country.

In short, with Dr. Hamilton himself we may conclude, that the sable picture he has drawn of the stormy nature of our climate, and its unfriendly disposition to the life of so hardy a family in the vegetable kingdom, is totally contradicted by experience, and may be overturned by a calm consideration of the phenomena themselves;* a consideration which, I trust, the reader will be convinced is not wanting in these pages.

SECT.

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* Hamilton's Memoir, page 40.

SECT. IV.

On the Growth of Timber Trees in Ireland.

DR. HAMILTON informs us, page 30, that he found and examined vast roots and noble trunks of the species of pine tree, denominated Scotch fir,* '*in situations where human industry cannot now rear a twig of the hardiest tree.*' And he asserts, that the *ash* flourished, in every district in Ireland, about fifty years ago, but that it is now, in many parts of the country, a victim to the scourging effects of the vehement gales, which have since borne upon this island chiefly from the western quarters.

Secured, he observes, by its deciduous nature from wintry blasts, the ash is, nevertheless, extremely sensible to the efforts of our summer storms, "and becomes a faithful register of the winds of our climate, "marking their most prevalent direction by the inclination of its boughs, and their violence by the "degree wherein its tender shoots, or more mature "branches, are withered or blasted."

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* The Scotch fir, (*Pinus Rubra,*) so called because growing naturally in the mountains of Scotland; it is common also in most parts of Europe. The wood of this tree is the red or yellow deal, which is of a very durable nature, especially that growing in Denmark, Norway, and Sweden. The *Pinus Cembro* is the species of pine that grows naturally on the mountains of Switzerland; the *Pinus Maritima* grows also naturally in that country; and the *Pinus Sylvestris* is the wild pine or pineaster.

" Half a century," continues he, " has scarcely " elapsed, since this useful species of tree was generally planted, and grew luxuriantly in every part of " Ireland: yet are there hardly any exposed places " in the kingdom where its top branches do not now, " (1794,) in one part or another, exhibit the withered vestiges of commencing decay. Through many " parts of Ulster it is a blasted tree; and in all unsheltered situations, in the three northern counties " of Antrim, Derry, and Donegal, the species seems " fast verging toward annihilation."*

Now let us examine in what measure this representation is justified by facts: At Ards, in the county of *Donegal*, on the shore opposite to Rosapenna, trees of various descriptions thrive extremely well, and amongst them the *ash* is none of the least flourishing. Five ash trees, partly in a grove and partly in hedgerows, were measured in April, 1803, and, at a foot and a half from the ground, were from 93 to 113 inches in circumference. One of these trees, at the height of from 2 to 4 feet above the ground, divides into three considerable arms, which, separately measured, gave a total girth of 163 inches, thus indicating great vegetative powers in the soil and air of the place. In the grove, are many stately ash trees of considerable periphery.

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* The county of Donegal, during Pagan times, must have been well planted; for it and Tyrone were the great seats of the schools of the diviners, soothsayers, &c. who were allotted the most romantic districts in the kingdom for their residence; and those places could not be romantic unless they had been well wooded. The name of the first county, or *Donna-gaill*, signifies the chief or head of the Augurs; the name of the latter county has a similar meaning. Collect. de Reb. Hibern. Vol. III. Preface, page 44.

Two sycamores, amongst many other large ones in rows, being measured, were 90 and 91 inches round. An oak, in the grove, was 88½ inches in circumference. In the barn-shrubbery, two American poplars were measured; one was found to be 48 inches, the other 46 inches in compass; the stem of one is nearly straight, and computed to be about 25 feet in length; the stem of the other is not quite so good. A larch, in a grove of mixed timber, measured 49½ inches round; and there are several such trees in the same plantation, which clothes the side of an eminence sheltering Ard's House on the west. In that plantation also, three silver firs measured from 61 to 76 inches in circumference; they are tall, graceful trees; and there are sundry others of a like description.

The ash, sycamore, and oak are supposed to be not more than 70 or 80 years planted. The poplars are 15 years old from the cuttings; the larches are about 30 years growth; the silver firs were brought young from the county of Fermanagh about 40 years ago; and the whole of these trees are in the most healthy, increasing state. The exposure is south-east, close on the eastern branch of Shiphaven; and the soil, in some parts, is pretty rich and deep; but, in others, it consists of a rossel shallow loam, often stony, with rocky masses frequently rising above the surface, generally kinds of siliciferous and calciferous argillite, penetrated with oxyd of iron. Near the shore are found quarries of grey lime-stone.

Besides these plantations there are woods on both the east and west sides of the adjoining hills, with wooded dells between them, which are exposed to south-west and north-west gales, yet thrive very well. Not only on this side the haven do trees thrive, but plantations advance on the opposite or western side, though so beaten, as we are told, with tides, sands, and storms. At Mr. M'Elhinny's, in Rosguil, are young ash, sycamore, and poplar trees in a flourishing state, reared under shelter of ditches in a situation exposed to the sea and the westerly blasts. In the same district, Mr. Moore proposes to raise plantations, and is preparing shelter by means of clay ditches, surmounted with a double row of wins or gorse. Nay, on the eastern side of Tull's mountain, where it was asserted that trees could not live, ash, and other kinds are now successfully raised.

Near the southern extremity of this peninsula, on a rising ground, ascending the lofty mountain of Loughsalt, a few years past stood a very respectable wood, directly facing the north-west; and from this place, throughout a space of some miles westward, in a rough mountainous country, several woods were growing, on exposed heights, within these forty years.

On the eastern side of Lough Swilly, in a tract of country extending several miles from north to south, trees grow well in sundry unsheltered places. At

Mallinhall

Malinhall is a respectable plantation, raised within these forty years, in a situation greatly exposed to the westerly winds. Mingled with the houses, in the pleasing hamlet of Fahan, are many considerable trees, amongst which are ash in a grove, in hedgerows, and individually, some of them indeed stunted, but generally in good condition, though exposed to powerful currents of wind from the south-west.

In the district called Burt, at Mr. Ferguson's seat, are many considerable ash and sycamore trees, on an eminence near a bay of Lough Swilly, very much exposed to every point of the westers, yet in general sound and stately; some of the ash are rather stunted, short in the stem, and flat in the top; and a few have suffered so much, as to have made it requisite to pollard them. One of the ash trees, near the garden cottage, on the side of the highway, being measured 1½ foot from the ground, in September 1803, was found to be 76 inches in circumference, with a fine extensive stem, and the branches generally safe. Another ash, on the opposite side of the road, measured nearly as much around, and, though more exposed to the west, is still less affected than the preceding tree. A sycamore, in the same row with the latter ash, is 75 inches in circumference, and is quite sound. These trees are reckoned to be not more than 60 years old. The soil, in which they grow, is rocky, shallow, and consists of a yellowish gravelly loam.

Between this and the following place are some ash trees in hedge-rows, which are greatly exposed to every blast from the west, and are scourged in part of their branches, whilst other parts are quite safe.

At Mullaney, in the same district, September 1803, some ash trees were measured 1½ foot above the ground, and found to be from 42 to 53 inches in circumference. In the same place are a number of equal magnitude, from 30 to 40 years old, all which, with many smaller ones, are not in the least degree injured by the winds, nor failed in any respect, but are in a very flourishing state. The situation is low, near an inlet of Lough Swilly, and pretty well sheltered from the north-west wind; but it is fully exposed to the south-west gales, which blow upon it through a gap and a long vale, that, like a tunnel, conduct the wind to the spot. The soil is a tolerably rich yellowish loam, and retains vestiges of its having been once covered with peat.

At Killderry, the family seat of General Hart, in the barony of Ennishowen, on the western side of Lough Foyle, the following are the dimensions of trees, measured in September 1803. A single ash tree, at the north end of the house, eighteen inches from the ground, measured 3 yards 12 inches round. This tree carries its stem to the height of about 8 feet, where it begins to branch and grow taper. Another ash, in an adjoining hedgerow, is 2 yards 10 inches in circumference. Both these trees are perfectly healthy; and, in the same place, are several fine thriving trees of the same kind.

On the east side of the house is an ash of considerable magnitude, being four yards in circumference. At the height of nearly 2½ yards, it divides into four principal arms, which extend their branches nine yards around; forming altogether a majestic, umbrageous healthy tree. Round the south garden are several tall, healthy ash trees, in hedgerows.

On the north side of the house is a sycamore, 2 yards 7 inches round, with a good stem, and in vigorous growth. In the neighbouring hamlet of Muff are some sycamore trees, of a still greater size, and quite healthy.

In each side of the long western avenue are hedgerows of common fir trees, which measure from 1 yard 8 inches to 2 yards 7 inches in circumference, very stately trees, and the majority of them without any bias received from the western gales.

On the eastern side of the house, next Lough Foyle, are a good many white poplars, in rows, several of them 2 yards 27 inches in circuit, with healthy branches and outside, but supposed to be somewhat decayed within, as those of the same decription, that were tried, had been found thus affected.

The trees in Kilderry, the oldest of which were planted prior to the year 1711, grow in a soil whose upper stratum is improved peat; and whose under stratum is either a gravelly loam, or a sea mud. They are situated in a flat space of ground, very much exposed to the south-west gales, which come forceably upon them over the course of the broad river Foyle, and a considerable vale, at least five miles in length.*

With respect to the growth of trees in the county of *Derry*, we begin with those in the shire-town. Surrounding the cathedral, at the highest part of the city, are 22 ash trees, nine of which were measured, September 1803, and found to be from 57 to 102 inches in circumference. Seven only shew any tokens of failure; the others are in perfect health; and those that do exhibit any symptoms of decline, might be preserved by proper management. The oldest of these trees were planted since the year 1689. There are also, in the chapel-yard, five large ash trees, of which but one is entirely alive; the other four are more or less decayed, but might yet be saved by pollarding. These trees, in both places, laboured under the disadvantage of growing, when young, within the skreen of stone walls and houses, which made them tender and susceptible of the attacks of hostile winds, as soon as they topped the skreens, yet they have arrived to the above magnitude, and a majority continue in good order.

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* At Killderry, young trees also thrive remarkably well; General Hart, within these three or four years, has planted above thirty thousand trees of various kinds, some of them in moory ground, without breaking up the general surface, but merely by opening holes and mixing the clay with the peat, afterward keeping them firm by surrounding them with the sods cut off the surface of the holes.

At the *Brow-of-the-Hill*, contiguous to the city of Derry, several trees were measured in September 1803. This is an agreeable sequestered spot, belonging to Alderman Lecky, situated on the western side of the eminence on which the city stands, and exposed to all the impressions of the north-west and south-west gales, which are conducted to it along the course of the river, and through the dell whence the promontory springs. This spot is one of the steepest parts of the height on that side, and is but slightly covered with a meagre loam, through which a naked shistose rock often protrudes. In this shallow soil, and on this precipitous slope, are rows of *ash* trees, some of which measure 56½ inches in circumference; they are also very respectable in height; and they all are perfectly healthy and flourishing. Besides these trees, there are some tall promising young ones of the same species.

On the summit of the hill are several comely beech trees, two of which were measured; one was 63 inches, the other 55 inches round. On the summit also, a tall larch tree measured, at 12 inches high, thirty-nine inches in circumference, and is not 27 years planted. Here likewise is a considerable number of comely thriving trees of the same kind, but few or none so thick as that one, yet all planted about the same time. On the summit is a flat of about half an acre, which produces very good culinary vegetables; and, amongst the forest trees, are fruit trees in tolerable bearing. From the southern end of this flat is an extensive and pleasing prospect, consisting of a considerable expanse of water, bounded on the sides with swelling cultivated grounds and some plantations, and terminated by distant hills.

At the base of the hill are two rows of elms, the largest of which are 2 yards round; the smallest 38 inches; and the larger size are more numerous than the smaller. These trees are not 40 years planted; and one elm, not 27 years old, measures 51 inches in circumference, and, though much exposed, is perpendicular and healthy. A row of the same kind of trees, on the north side of the improvement, with the broadside to the north-west blasts, is straight and thriving. The elms are the most numerous trees in this plantation, and are reckoned to amount at least to two hundred, all in a flourishing state, except the Scotch species, which do not thrive here so well as that called the English.* In the dell are many ash trees, in hedgerows, none of which appear to have suffered from the north-west and south-west currents, to which they are so fully subjected.†

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* The English elm, improperly so called, because it is not a native of that country, is the *ulmus nativus*, or small leaved elm. That kind, denominated Scotch, is the rough or broad-leaved elm (*ulmus scabris*), or witch hazel.

† The whole of this sylvan spot, being as it were under the back of the town, is hid from view, and is thus prevented from contributing what is much wanted, arboreal objects, to the engaging scenery which surrounds our city.

Prehen, the seat of Andrew Knox, Esq. is 1½ mile south of Derry, on a swelling ground rising from the shore of the river Foyle, facing the west, and exposed to the blasts from every western point. The dimensions of trees measured here, in September 1803, is as follows: Five beeches, two single and three in a grove, are from 68 to 95 inches round, fine trunks, and in flourishing order. Several more handsome beech trees are in the same grove, and others in a row close to the water's edge; where also are many stately ash and good sycamores. This row presents a broadside to the westerly winds, yet the trees are perpendicular, without any bias from the impulse of those winds. Two of the ash trees were measured; one was 1 yard 29 inches, the other 2 yards in circumference. These trees are, in general, not more than 50 years planted.

In the same grounds are scattered trees and hedgerows, fir, ash, sycamore, &c. on the acclivity of the hill, exposed to the westerly blasts, and yet very few of them have any degree of leaning in the opposite direction. Near the summit of the hill is a grove of thriving ash intermixed with fir, all straight and unhurt by the winds, though much exposed to every blast from the unfriendly quarters.

The soil of Prehen is a pale yellow rossel loam, interspersed with some of a faded slate colour, spewy, incumbent on a fossile substratum of shistous flag, in several places in considerable masses, rising to the surface, and producing good quarry stones, which harden greatly when exposed to the air.

Willsborough, the seat of James Scott, Esq. is in a flat situation, on the eastern shore of Lough Foyle, exposed to every point of the west, and yet ash, oak, beech, sycamore, larch, &c. thrive extremely well in a quick moss. At Walworth, on the same side of the Lough, equally exposed to the westerly blasts blowing over an oozy beech, is a large tract of venerable forest trees, growing in a soil, in general, no better than a cold till of blue clay, with other inauspicious kinds of soil, yet advanced to the above-mentioned perfection.

Steep declivities, at Mr. Ross's lodge near Newton, are clothed with thriving trees. At Ballyrena, in a light sandy soil, plantations succeed remarkably well, though near the sea and exposed to the north-west. A high gravelly bank, at Summerseat, is wooded to the top. On a rocky eminence, Mr. Curtis has effected considerable improvements; and Mr. Staples, of Lissane, has decorated a secluded recess of mountainous territory with ash, beech, larch, fir, &c.

At Downhill, a rugged declivity, on each side the glen opening to the west, is planted and intersected with walks; but the trees have suffered from the winds of the place, where the interior side of the curve landlocks the exterior; from which place the planting becomes healthy and strong. At Ballymaddigan glebe, another very extensive bank is planted with ash, oak, pine, larch, &c. which are thriving luxuriantly in a soil of bluish clay.

Those places, in which the nipping effects of the north-west have proved most injurious to trees and shrubs, on the coasts of the county of Derry, are found to be where they are planted behind the shelter of high loose walls. Their sparing growth sprouts all from the side most distant from the sea, leaving to the blustering pursuer a rugged, wounded, and blighted rear, as soon as they raise their tops above their skreen. Although particular instances are mentioned, where exposure to the sea and northwest winds have repressed the growth of trees, Mr. Sampson seems persuaded, that, by proper management, the bad and rocky heights throughout the county might be advantageously covered with hardy trees*.

In the county of *Antrim*, trees thrive in lofty, bleak, maritime situations. At Fairhead, the most northern extremity of Ireland, and exposed to the fury of the north sea; the mountain ash, the birch, the oak, with other indigenous trees, grow luxuriantly within 15 or 20 yards of high-water mark. In every other part along the coast, where land is of the same form, viz. very high; it is covered with thriving wood, but where the surface is nearly level, for a length of way inland, no wood appears, and not a hedge is seen to rise higher than the top of the bank which protects it from the wind. Amongst the rocks, on the eastern face of Agnew's hill, the aspen tree grows luxuriantly, at about the elevation of 1450 feet; and on the top of Sliebh-Mish, at the height of 1390 feet, the mountain ash flourishes in the face of every storm.*

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* Statistical Survey of Derry, p, 411, 443.

In the neighbouring county, Down, the greater portion of the mountains in the baronies of Mourne and Upper Iveagh, estimated to contain about 30,000 acres, is composed of such rocky steeps and precipices, as preclude any possibility of improving them, except by planting; which has been performed on one part to the extent of 300 acres, by the late Lord Clanbrassil. During many years he planted from 30 to 60,000 trees annually, with which he completely covered one of the lower mountains; close to which is situated his most uncommon improvement, wherein every variety of wood, water, mountain, combine with frequent views of the sea, to form a succession of highly romantic scenery. In another part, on the Mourne side, Mr. Needham inclosed and planted a considerable tract, which, from the growth of the trees, and the beauties of the streams that flow through it, promised to be little inferior to Lord Clanbrassil's, Tullymore park.†

The face of the county of Tyrone has been greatly improved within these last 17 years, in which short space of time, a great part of the planting has

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* Trans. R. I. Academy, Vol. VIII. Science, p. 126, 129.

† Statistical Survey of Down, p. 169, 170.

has been accomplished. Since the year 1791, Lord Mountjoy has planted above 346 acres with 820,732 trees; and, from the year 1784, he has given several hundred thousand young trees to gentlemen, and to his tenants. The Marquis of Abercorn has planted largely at Baron's Court, and the plantations are going on prosperously. It was included in the original design, to plant out the greater part of the north side of Bessy Bell mountain, which overlooks the Marquis's demesne. Greater difficulties than that have been fairly overcome by Lord Mountjoy, at Rash, within these 15 years.

Amidst the dreary mountains of Drumquin, the Rev. Mr. Hill has ornamented his glebe grounds with success. At Athenree, Sir John Stewart also has planted, with taste and judgment, in a mountainous situation; and, like a real planter, he laid a good foundation, by establishing his own nurseries. There are many other instances of modern planting, viz. by Lord Northland and his son Mr. Knox; Lord Callidon; Sir William Richardson; Mr. Montgomery; Mr. Moutray; Mr. Eccles; Mr. Lendrum; Mr. Lowry, &c. all in a thriving state.*

The county of Cavan is situated high, is much exposed, and naturally cold and boisterous, yet there the woods were formerly very considerable, and the timber of uncommon size; which argues that the soil is favourable to plantation; but demesne grounds now only can boast this valuable ornament. Nevertheless, that the soil and climate are friendly to the nature of trees, is evident from the growth of shrubs which spring out of the very fissures of the rocks, where they flourish amidst the mountainous wilds, and defy the inclemency of the winter, a season reckoned particularly severe in that county.*

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* Statistical Survey of Tyrone, p. 15, 16—174, 179.

The ash-wood at Glaslough, in the county of Monaghan, covers 100 acres, and is accounted the finest timber in Ireland; for 1000 trees of which the proprietor was offered 6000 guineas on the spot.† From this and the preceding facts, we have no reason to accede to Dr. Hamilton's position, that "through *many parts* of Ulster, the ash is a *blasted* "tree."

On the western coast of Ireland, in the barony of Morisk, county of Mayo, vastly exposed to the westerly blasts, almost covered with considerable mountains, and invested with the Atlantic ocean and bays formed by it, the Marquis of Sligo has a prodigious extent and variety of plantations, some of them quite near the sea. And, in the adjoining barony of Burrishool, under circumstances apparently no less adverse to vegetable growth, the few hedges and trees about Newport are living proofs of the facility with which trees would grow there by proper culture, Hence the writer of the County Survey, Dr. M'Parlan, is convinced, that if the numerous islands in Newport or Clew Bay were planted, and the necessary parts of the banks and mountains wooded and improved, the bay would certainly exceed, in picturesque beauty, any thing of the kind in Europe, the bay of Naples *not* excepted.*

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* Statistical Survey of Cavan, p. 32.

† Statistical Survey of Monaghan, p. 30.

The county of Dublin is replete with elegant country seats, improved demesnes, fine gardens, hot-houses, green-houses, &c. which hardly can be surpassed in the kingdom; but the waste grounds and mountains, which are very considerable, seem to be rather neglected. Many parts of the mountains, it is true, appear totally unimproveable, being covered with loose rocks destitute of soil; yet, even in these cases, expedients might be used to raise trees in them: thus, if the seeds of various hardy trees were dropped in the crannies of the rocks, numbers of them would vegetate, and the expense would be trifling, whilst the better covered parts might be planted from nurseries. William Caldbeck, Esq. is the principal improver of mountainous grounds. In 1796, he took a large tract of waste land, one half of it absolute mountain, high, steep, and on the top almost entirely covered with stones. By means of a wall he enclosed the rocky summit of the western declivity, amounting to 130 acres, and planted it with above 87,000 trees,

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* Statistical Survey of Mayo, p. 11—115. In the adjoining county, Galway, Lord Clanricard has raised large plantations on the mountains. Stewart's Reports.

trees; consisting of oak, ash, larch, fir, sycamore, &c. which succeed extremely well.[*]

The predominant features of the county of Wicklow are mountains and rocks; in the mountains and adjacent to them the planting has chiefly taken place, and the trees seem all to be in a thriving state. At Avondale, a seat highly improved by that distinguished arborist, the late S. Hayes, Esq. a hill is crowned with large beech, and remarkably well grown firs; and some steep, abrubt precipices are covered with old oak, the roots of many of which are 100 feet perpendicular over the tops of others. The hill of Latouche, which is a stupendous height, is covered to the summit with planting, arranged with great judgment and taste. Mr. Greene has planted extensively in a mountain, where the trees are growing well. The Marquis of Waterford has a fine skreen of planting, judiciously disposed on the brow of a mountain.[†]

Wicklow is a truly interesting county, rich in the sublimities of nature and in the improvements of art; abounding in stupendous mountains, beautiful lakes, fertile vallies, and ornamented villas. There, are the justly celebrated scenery of Powerscourt and the Dargle; the finely wooded demesne of Charleville; the elegant villas of Bushypark and Ballygornan; the beautiful grounds of Tenehinch; the fine vales of Glencree and Imale; the picturesque Glen of the Downs and Dunran; the verdant improvements of Mount Kennedy; the magnificent scenery of Ballyarthur, remarkable for the finest growth of oak in that part of Ireland; with many other beauties which would require volumes to describe.*

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[*] Statistical Survey of Dublin, p. 97, 109, 210, 218. Irish Agricultural Magazine, Vol. I. p. 209,

[†] On the maritime side of the county of Wicklow, the oak, the ash, the beech, the fir, the yew, &c. grow to a great size both in circumference and height. And at Courtown, county of Wexford, there is a vigorous growth of timber on the sea shore, almost to the water's edge.

Of the growth of timber in these two last mentioned counties, in the Museum of the Dublin Society, are the following examples: a larch, 20 inches diameter, thus inscribed, "This larch was planted "by Sir W. G. Newcomen on the lands of Kil-"lester, county of Dublin, at two years old in "1771, and cut down in 1788." The other a spruce fir, 18 inches in diameter, on which is incribed, "this fir was transplanted by Samuel Hayes, "Esq. at Avondale, in the county of Wicklow, in "1764, then about five years old from the seed, "and was cut down in 1786, the 25th year from "the seed."

Proceeding still farther south, we shall find that the ash tree thrives remarkably well, and that it constitutes extensive groves of full grown timber. As to size, the *great ash* of Leix or Lea, in the Queen's county, has long been the most distinguished. In circumference it is equal to that of the bodies of six large horses; and its small limbs are equivalent to the trunks of large trees. At about 200 yards distance stands another ash, of much the same figure, and of considerable girth, though very inferior to the former tree.* The great ash, at *one foot* from the ground, measures 40 feet 6 inches in circumference. Considering the natural difference between ash and oak, this fine ash tree will bear a comparison with the renowned *oak* at Cowthorpe, near Wetherby, in England, whose circumference, *close* to the ground, is 78 feet, and at *three* feet from the ground, it contracts to 48 feet in girth. But considerable as the magnitude of several of our forest trees are in other places, unquestionably they are exceeded by many of the same kind in England.

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* Statistical Survey of Wicklow, p. 39, 266.

In the county of Kilkenny, the ash tree thrives extremely well. The largest of those trees in the county, is supposed to be near Durrow House; in summer, 1801, it measured, near the ground, 19 feet 4 inches in circumference. At Westcourt, an ash tree, two feet from the ground, was 12 feet 7 inches in girth. In the demesne of Bessborough, and at Castletown, are ash trees of considerable size. At Marymount, the increase of ash is 1½ inches round, in one year. In thirty-two years were registered nearly 140,000 trees, amongst which are above 20,000 ash. This tree sows itself in the woods of this county.†

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* Statistical Survey of Queen's County, p. 136. For specimens of fine ash trees, see Hayes on Planting, p. 120, 151.

† Statistical survey of Kilkenny, p. 275, 578.

Long observation convinced Mr. Hayes, that the ash tree is capable of arriving to the utmost perfection, in a greater variety of soils, and under a more severe exposure than any other tree, even in situations subject to violent blasts from the sea. At the same time allowance is to be made for injuries from other quarters and sources, to which this tree is obnoxious. It is hurt by the adhesion of green cupthong, *(lichen virens)*, ash cupthong, *(lichen fraxineus)*, hornbeam cupthong, *(lichen carpineus,)* and lungwort, or *pulmonarius*. Besides the ridges which run longitudinally in the trunk of the ash, form channels for the rain to descend in; where this is remarked by noticing any change in the colour of the bark, that part of the tree is certainly rotted by water, and it frequently pierces to the heart. Some of those trees will have their entire surface, from root to branch, affected with this fluted appearance, and will be perfectly sound; but by a particular attention to the colour of the bark, or to a small fissure in the furrow, the decayed timber can be distinguished from that which is sound. Ash which has grown in woods and best sheltered, is most exempt from this imperfection.* From these circumstances, and the saccharine quality of the ash sap, before mentioned, we may at once perceive that such failures as happen in these trees are not to be ascribed solely to the influence of gales from the west. And, upon the whole, we may now fairly conclude, in opposition to the assertion of Dr. Hamilton, that in *many* exposed places in Ireland, the top branches of the ash tree do *not*, for the most part, exhibit the withered vestiges of commencing decay.

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* Hayes on Planting, p. 147. Withering's Botanical Arrangement, Class XXIV. 425—10, 29, 45, 54. Statistical Survey of Armagh, p. 51. The first species of lichen, the *virens*, is reckoned to be more frequent on the ash tree, than even the *fraxineus* in Ireland. The common seed-bearing ash never thrives without the company of the stameniferous tree.

SECT. V.

On the growth of fruit-trees, shrubs, and flowers in Ireland.

As a proof that the climate of this country is changed, it is alleged, that trees, which formerly produced plenty of rich, mellow fruit, now yield but a crude insipid scanty crop. Cambrensis saw but few apple trees in Ireland; a paucity, he says, not owing to the unkindness of the soil, but to the indolence of the people; for those brought from abroad flourished very much. Notwithstanding this concession, a decided admirer of Cambrensis attempts to account for the rarity of apple trees here at that period, by remarking, " that a cold savage " country, with swamps and forests, has but few " indigenous fruits."*

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* Ledwich's Antiquities, p. 219. Here I crave the reader's attention to two obvious inferences, deducible from the above report

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This remark is at once too general to be admitted as an opposite argument in the question, and is totally inapplicable to Ireland, which, from the earliest authentic records, and even from the testimony of Cambrensis himself, as already shewn, has been distinguished for the genial temperature of its air; a characteristic, which compared with neighbouring countries, it preserves to this day. In a climate thus generally mild, the existence of swamps and forests has not the same unfriendly influence on fructification, that is caused by a climate of intemperature, whether in relation to cold or heat.

Dr. Ledwich grants, that, from the establishment of Monachism, in the 5th century, the Irish ecclesiastics, during several ages, paid particular attention to gardening, especially to the culture of culinary and medicinal plants; and that, according to Lombard, in 1632, artichokes, cauliflowers, pompions and hops, grew very well in this country. At the same time, if not earlier, the vine was cultivated here, at least for the indulgence of the monks; and Lombard thought it might have been cultivated to greater extent, believing that the grapes of this country would, with equal care, yield as good wine as those of France and Germany.

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, viz. that, before the 12th century, apple trees were
re, and that they wanted only proper culture, which
every country, to render them productive.

There is reason to believe, that the vine might be naturalized to our climate; as we find has been done in the case of other plants, natives of various parts of the world, Chili, Mexico, Peru, Egypt, America, &c. which are now brought to bear the open air in our severest winters.* The vine grows naturally in those countries, whose vegetable productions we are capable of thus harmonizing with our climate; and it grows advantageously in Switzerland, whose weather and seasons we shall presently shew, are vastly intemperate compared with ours. Why then might not equal care and skill raise tolerably good, if not exquisitely flavoured grapes in this country, particularly in the southern counties.

In the northern counties, the vine is successfully cultivated under glass.† A Syrian vine at Mount Stewart, county of Down, 1800, produced 278 bunches of grapes, which weighed from 3 to 8lbs. a bunch; the average of which is 5½lb., and this at 1s. 1d. per pound, would amount to the sum of £86 9*s*. sterling. The vine covered a space of 800 square feet: it was first planted at Newtown Ards, in 1769, and transplanted at Mount-Stewart, in 1780; so that it was above thirty years old, when it bore this vast quantity of fruit, which, at the average weight, would amount to 1529 lbs.

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* Memoir on the Naturalization of Plants, by Mr. Templeton, Trans. R. I. A. Vol. VIII. Science, p. 111. This ingenious botanist has there given a very favourable specimen of the application of meteoric knowledge to the culture of plants, and of the utility of science in promoting the arts.

† We are told, that the first hot-house in Ireland, where fruit was forced, was in the gardens of Blessington, County Wicklow, which were laid out by a gentleman who fled from England, to escape the persecution of Cromwell. Trans. R. I. A. Vol. IV. Antiquities, p. 13.

The air of a country must be congenial with the nature of a plant, otherwise by all the contrivances of art it cannot be brought to perfection. For common experience proves, that a plant kept in a greenhouse, and covered entirely with glass, will not grow to any degree of perfection, if the doors and windows of the house be constantly shut. Hence it is plain, that no dependence should be placed on experiments made by setting plants to grow in glass bottles, or under receivers.* Hence also appears in what measure the above produce of the Mount-Stewart vine is an example of the genial disposition of our climate to delicate plants, and the maturation of their fruits.

Above 170 years ago, Peter Heylyn informs us, that the vines in England were usually nipped by cold, and seldom came to maturity; in which fate, we may reasonably suppose, other kinds of fruit more or less participated. If this were the case in England, should we expect that it would be totally otherwise in Ireland? But our murmuring horticulturists never revert to past times for information, extend not their views beyond their own enclosures, and have neither discernment to see, nor candour to acknowledge, the errors of their own management.

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* Fordyce's Elements of Agriculture, page 65.

Attention, skill, and address in the conduct of several circumstances, are, in fact, absolutely necessary to raise and preserve productive fruit-trees. First, the situation in which they are planted requires consideration. For instance, a somewhat elevated situation, if sheltered from strong winds, is preferable to a warm, low, confined place; and in the naturalization of plants, when they are affixed to a wall, care should be taken to secure them against strong winds, together with the effects of hoar-frost, which injure, if they do not destroy, the leaves and young shoots of vigorous, as well as those of weakly plants.

The next circumstance, particularly with regard to orchards, is, the distance at which the trees should be planted from each other. Fruit trees planted too close, even forty feet asunder, impede the access of air, light and heat, which are essential to ripening their produce; and, when planted so close as twenty feet, they very soon become rough and fogged. If, on the contrary, those kind of trees were planted at greater distances, grass, clover, or grain might be cultivated amongst them with advantage; especially if each standard were kept pruned to a good height, for the purpose, on this occasion, of letting horses pass under. Eighty trees on an Irish acre would give very little obstruction to the usual tillage; and, allowing only four shillings a tree, the profit would be 16*l.* which would amply compensate the additional trouble of fencing, watching, &c.*

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* Statistical Survey of Derry, page 440.

Another material consideration is the method to be used in pruning; by which, if judiciously done, the trees will come into bearing sooner, and continue in vigour nearly double the time. In the process of pruning, it is unnecessary to pay any attention to fruit-branches and wood-branches; but to take care that no branch be shortened, unless for the figure of the tree, and then constantly taken off close to the issuing spot, which causes the wound soon to heal. The more the range of the branches shoots circularly, a little inclining upwards, the more equally will the sap be distributed, and the better will the tree bear; because, from that circumstance, the sap is more evenly impelled to every part. The range of branches should not be suffered to remain too near each other; for all the fruit and the leaves should have their full share of the sun; and, where it answers, let the middle of the tree be free from wood, so that no branch shall ever cross another, but that all the extreme ends shall point outwards. This mode may at first be supposed to render the trees too thin of wood; but they will be handsomer, and, what is of most importance, the fruit will be better, and of course will bring the best price at market.

When trees are much thinned, they are subject to throw out a great quantity of young shoots in the spring, which should be carefully rubbed off, not cut, for cutting increases the number. Nothing but prejudice can make a person think, that a tree, overloaded with wood, will produce good fruit; as well might a crop of good turnips be expected without hoeing and thinning.

It is constantly observed, that when the stem of the tree grows too fast for the bark, blotches and lacerations are the consequence; an evil which is obviated by scoring the bark with a sharp knife: but care should be taken not to cut through the whitish rind next the wood; for that heals with great difficulty, generally ulcerates, and, by being cut through, gives insects an opportunity of getting between the wood and bark, where they are very destructive.*

In general, to strip off the bark of trees is to kill them; and yet there is, in certain climates, a time of the year when apple trees may be peeled from their roots to their boughs, quite around, without sustaining any damage from the operation. On account of defects, single trees, nay whole orchards, have been thus treated, in America, with apparent safety to the trees, and satisfaction to the proprietors. The season for doing this is toward the end of June and beginning of July, when the days are longest, and the weather warm. The new bark is remarkably smooth, resembles the bark on very youthful plants, and, according to the reports thence received, the process makes old trees young again.

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* Repertory of Arts, Vol. I. page 25. The bark of trees consists of three *lamina* or layers; an outer, rough layer, the *cortex*; a middle, soft and spungy, the *liber*; and an inner, or whitish rind, the *alburnum*, which joins the whole to the wood, and which is supposed to contain the sap, whence it is termed the sap-wood, and it is likewise called *adeps arborum*, or fat of trees. The centre layer, or *liber*, is so denominated from its being that on which the ancients wrote their *libri* or books.

In corroboration of the safety and utility of this practice the cork-tree is instanced, which bears the operation 150 years.* But whether this practice would be equally safe and useful in Ireland, is a question which I shall not presume to determine. I mention it merely with a view of giving a precedent, and an opportunity to apply the principle in remedying the defects of our apple trees, which often very much require the hand of art, to retrieve them from failure and insignificance. However, be the expedient safe or hazardous, it is an expedient which demonstrates a vast power in the vegetable economy.

What has been ascribed to the change of climate in Ireland respecting the inferior production of the fruit-garden, may be owing to the generation of unknown insects, which devour the fruit and are not observed. Within these few years, an insect, before unknown in England, made its appearance in the orchards of that country, committing prodigious havoc on the apple trees; and, it is not improbable, that, until this cause was discovered, most people ascribed the deterioration of the fruit to a revolution in the climate.*

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* New York Repository, Vol. III. page 420. id. Hexade II. Vol. I. page 42. A species of decortication, *girdling*, that is, depriving trees of a ring of bark near their roots, is also proposed as a cheap and easy method for increasing the strength and durability of timber. Not only girdling, but stripping the bark off the trunk to some height, is thought to be a beneficial measure. Massachusett's Papers on Agriculture, page 23, 39. This practice was intimated by Vitruvius, above 1800 years ago, was spoken of by Evelyn in the 17th century, and tried by Buffon and Du Hamel. The effect is supposed to be occasioned by the trees, on account of the privation of their bark, gaining a lingering life for a certain time.

In America, the decay of peach-trees is imputed to a worm which originates from a large fly, that resembles the common wasp. This fly perforates the bark, and deposits an egg in the moist or sappy part of it; generally close to the surface of the earth. Mr. Ellis, of New Jersey, has discovered a method of frustrating the baneful effects of the deposition. For this purpose, he binds straw longitudinally around the tree, from a few inches below to nearly three feet above ground, and removes it when the white frost appears. The naturally slow motion of the worm, though the egg were deposited above the straw, exposes it to perish in the cold, before it can take shelter in the earth.

The death of young peach trees, in Pennsylvania, is ascribed principally to planting, transplanting, and pruning the *same stock*, which occasion it to be open and tender, with a rough bark; in consequence of which, insects lodge and breed in it, and birds search after them, whereby wounds are made; the gum exudes, and in a few years the tree becomes useless. To prevent this, Mr. Coulter advises to transplant trees as young as possible; if in the kernel, it will be best, as there will then be no check of growth. Plant them sixteen feet apart. Plough and harrow between them, for two years, without re-

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* Philosophical Magazine, Feb. 1799, page 89.

gard to wounding them, but avoid tearing them up by the roots. In the spring of the third year after transplanting, cut them all off close to the ground, plough and harrow among them as before, but with great care to avoid wounding or tearing them. Suffer all the sprouts or scions to grow, even if they should amount to half a dozen or more; they become bearing trees almost instantaneously, on account of the strength of the root. If any of the shoots from the old stump should happen to decay, cut them away; they will be supplied from the ground by others, so that trees may be had from the same stock during 100 years.

The highest ground, in that country, is stated to be the best for peach trees; and the north side of hills is most desirable, as it retards vegetation, and prevents the destructive effects of late frosts, which occur there in the month of April. These trees require not a rich soil; the poorer the soil, the better the fruit; whilst a middling soil produces the most bountiful crop. It is considered bad husbandry to manure peach trees. By manuring them the trees are indeed larger and apparently more flourishing; but their fruit is always smaller, looking green even when ripe, and inferior in quality to that of trees which are not manured.*

Several

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* American Philosoph. Transact. Vol. V. Appendix, published in 1802. The above cases may not be strictly applicable to the treatment of peach trees in Ireland; but they may furnish hints which may, some time or other, be turned to advantage in horticulture here.

For

Several shrubs and flowers, which hold a distinguished rank amongst the favourite productions of the modern garden, grow naturally on the lofty mountain of Mangertan, in the county of Kerry, not a little exposed to the western and soush-western gales. Amongst the shrubs are the arbutus and myrtle, justly admired for their beauty and delicacy; the former said to be introduced here in monkish times.* Even were it introduced here by the monks, it forms no objection against the climate; on the contrary, it furnishes an argument in its favour, as it testifies the benignity of our air and soil to the vegetable race, if any farther testimony were, at this day, requisite. In respect to flowers, we may observe, that the rocks, on the great range of mountains, called Muskerry, in the county of Cork, are covered with the elegant little flowering plant, commonly known by the name of London-pride, *sedum montanum*.†

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For instance, instead of training peach trees along a wall, might not cultivating them as standards, in the American manner, be practicable in this country, and attended with more ease and produce, than our present custom?

* The Irish name of the arbutus is *crann-comar*, sacred, or literally priest's tree. Vallancey's Prospectus, page 26.

† Rice, which is an aquatic, might be naturalized to our climate; and, in fact, it was cultivated here in 1585. With respect to the naturalization of plants, there is an agricultural plant in America, natives of which country thrive perfectly well here) which seems calculated to be very beneficial in Ireland. It is called the Northampton or Magathy-Bay bean, Accomac pea. It grows in almost every kind of soil, however poor by nature, or impoverished by exhausting cultivation. The principal use to which it is applied there, is as a manure, for which it is greatly prized, on account of its preserving the land from being worn out, under the severe system of exhausting

In the year 1794, a fruit tree and a flowering shrub, a *cherry* and an *arbutus*, were standing in the county of Wicklow, which scarcely have been equalled. The former, at 5 feet from the ground, measured fifteen feet in circumference, was then in perfect health, and in full bearing. The latter, which is held to be the most singular shrub in this or any other country, is the celebrated arbutus at Mount-Kennedy, noticed by Mr. Fortescue, and by Mr. Young. In the year 1773, the stem, below its first division, measured 13 feet 9 inches round; and circumstances proved that its age then exceeded *one hundred years.*

The myrtle flourishes in the wilds of the counties of Wicklow and Wexford; and I have seen it grow, in the northwest part of the county of Donegal, to a considerable height and in great luxuriance, along the south-east wall of a respectable mansion, in the neighbourhood, too, where the north-west wind is said to be so unrelentingly hostile to the woody tribe. In the county of Down, myrtles grow to a large size, without covering of any kind during the winter months.* At Glenarm, in the county of Antrim, latitude 54° 56′ N. the common myrtle grows with great luxuriance contiguous to the sea, and braves

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ing cultivation, for twenty years together. The seed may be sown with oats, or other ſmall grain, in the spring, giving from a pint to a quart, *only* to an acre. New York Repository, Vol. VI. page 273.

* Statistical Survey of Down, page 163.

our coldest winters. Hence it is seen, that in Ireland, as well as in Italy,

> '*Litora myrtetis lætissima*'.
> Gay myrtles blossom on the sea-beat shore.

SECT. VI.

On the Climate of Scotland, Norway, Sweden, Russia, and Switzerland; and on the Growth of Trees in those Countries.

TREES, it is well known, grow and arrive at a great size in regions infinitely colder than the most elevated and exposed districts in Ireland; for example, in the bleak Highlands of Scotland.* Scientific observations on the weather in the Highlands are not, as far as I know, yet before the public; but, if we estimate the climature of those tracts according to that of the south-east and west districts of the Scotch Lowlands, we would find, that they are very inferior to Ireland in an essential requisite to vegetable life, namely, a temperate constitution of air. From observations made at Hawkhill, Branxholm, and Selkirk, it appears, that, of 6 terms, whose minimum is 1° 50′ and maximum 81°, of Fahrenheit's scale, the medium is 31° 25′; and, if to this we add the rate of cold, which occurred at Glascow; in January 1780, viv. 14° below zero, we have a medium and a minimum degree of temperature, which never could have been experienced in Ireland. In those places, during the space of from 8 to 10 years, the westerly winds were to the easterly in the proportion of 461, 6. to 268, 8.*

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* The Highlands comprehend the west side of Scotland, from Cantire to Pentland Frith, with the Hebride Isles; also the interior part of the country, from the Frith of Clyde, Loch Lomond, and Loch Tay northward. The medium lat. of the Highlands is 57° N.; the medium long. 6° 30′ W.

The highland isles may be rather warmer than a calculation from the above data would produce, owing to their insular form, together with the influence of the Atlantic and Gulph Stream. This ſtream reaches the coasts of North Britain, in a communicative state, about Christmas, when, at the Orkneys, (lat. 59° N.) the water is remarkably warm for the season, which may be the reason that frost scarcely ever lies there.† Still, however, there is not any ground to suppose, that those isles, (much less the continent of Scotland,) are blessed with the like genial air that attends our island, which enjoys not only the warming influence of those waters more early and ample than the Scotch isles, but other natural advantages with respect to temperature.‡

The western coasts, on the continent of the Scotch Highlands, particularly the banks of the lakes, are generally fringed with natural woods, rising beautifully from the shores toward the summits of the mountains.

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* Edinburgh Trans. Vol. I. Part. I. Art. IX. XII.

† Kirwan's Estimate, Chap. III.

‡ The conclusion respecting the comparative intemperature of the Highlands, we shall presently find corroborated by popular observation.

These woods, some of which are several miles in length, are composed of oak, ash, elm, larch, pine, fir, &c. Nor is it in natural woods only, that the Highlands excel. The sturdy oak, and the hardy pine, offspring of industry, wave their branches over impending precipices, deriving energy and strength from the boisterous elements of that climate.

A small species of oak, which grows spontaneously on their hills and rocks, is remarkably valuable. The bark supplies the tanner, the net, and sail-maker; the wood is consumed in various works of glass and metal; and the trees are cut down every 20 or 25 years. The price is regulated by the demand; and the demand by the progressive state of arts, manufactures and commerce in those countries; consequently the value of this timber may be supposed to be always advancing.

The face of the Highlands, in which these plantations flourish, exhibits one great mass of rugged mountains, appearing in all manner of directions, patched on the sides with natural woods, or covered with heath, and on the summits capped with everlasting snow. These mountains are separated from each other by vallies or glens; and, in some places, by narrow deep chasms, darkened with timber, through which the united tributary streams of the surrounding mountains roll with great impetuosity.

Such being the natural state of the Highlands, the only parts capable of agriculture are the vallies or glens around the basis of the mountains; and these vallies having the sun only during a few hours, vegetation advances slowly, and the harvests are always late. The temperament of the atmosphere is equally discouraging to the purpose of husbandry. The spring is bleak and piercing; the summer is cold and short; the autumn deluged with rain; the winter long and tempestuous. No wonder, then, that grain is raised with difficulty, and is insufficient to maintain even one third of the impoverished inhabitants.

However, the result of trials, recently made in Scotland, places beyond a doubt the practicability of raising timber in their hilly situations; for instance, the extensive and thriving plantations of the dukes of Athol and Argyle, the Earl of Galloway, and many others. Amongst these we have a particular example, which seems applicable to several tracts in Ireland. Sixteen years ago, thirty eight acres of heath land were inclosed, and planted with Scotch firs intermixed with larch, which, in 1802, were from 12 to 18 feet high. The soil, which is about 3 inches in thickness, is of a black sandy kind, upon a yellowish, till about 12 inches deep, studded with whinstones of all sizes. The heath was extremely stunted, and the ground altogether exhibited a most barren and uncultivated appearance. In room of the heath, which gradually vanished, came up sweet small bent and sheep's fescue grass, *agrostis sylvatica* and *festuca ovina*, which are not only perennial but evergreen. On this pasturage, sheep are kept from ovember to March, but are not admitted in summer; (a custom which is called *haining*;) and no other cattle are suffered to go on it. The shade extirpates the heath; whilst the summer reserve brings up and propagates the grass, by means of all the seed shedding on the land.*

Norway is craggy, abrupt, and mountainous, diversified sometimes with fertile and even delightful spots. Besides the vast chain that runs from north to south, there is a great number of attached mountains, together with groupes, some of which exhibit very remarkable appearances, and the summits of some are capped with eternal snow. The soil is too thin for the plough; corn is therefore obtained from the neighbouring states; and the chief agricultural employment of the peasants is grazing. Great part of the kingdom is covered with forests, principally fir and pine, which furnish their chief articles of commerce.† The forests are so vast and thick, that the people seem to think there can never be a scarcity of wood in that country, especially as the soil is peculiarly adapted for the production of timber: they therefore destroy it with a wasteful hand; insomuch that more wood rots in Norway than is burned in the whole kingdom of Denmark.

The climate of Norway is very different in different parts of the kingdom. On the west side, next the

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* Edinburgh Agricult. Magazine, May 1802.

† Norway produces also some forests of oak; plenty of elms; ash, and many other trees which flourish there. Hazel grows in such abundance, that 100 tons of the nuts are annually exported from Bergen alone.

Northern Ocean, the winter is moderate; on the east, the cold generally sets in with great severity about the middle of October, and lasts till about the middle of April. The range of the thermometer is of great extent; in the summer having risen to 88°, and in the winter fallen to less 40°. In general it is between 80° above zero and 22° below it, that is, with respect to cold, 54° colder than the point of congelation.

The predominant feature of *Sweden* is rock, but its nakedness is in general covered with moss, or shaded by pines; and the traveller contemplates almost one extensive forest, broken with frequent lakes, and leaving only some small spots, where the scanty soil is capable of cultivation. In their woods some oaks are observed, but they are rare, and stunted, or decayed, except in the deer-park of Stockholm, where there are a few of a considerable age and size. The thermometer is reduced by the cold of winter to less 13° or 45° below the freezing point. At Upsal, lat. 59° 51′, the cold sometimes reaches to 25°; and the same species of vegetables bud a month later there than they do near London.

With respect to the climate of *Russia*, we shall take for instance Petersburgh, which stands in lat. 59° 26′ 23″ N. From the 27th of November to the 19th of April, the rivers are completely locked up with ice; which, again the month of February, acquires the astonishing thickness of 27 inches. The cold is often 30° below zero of Fahrenheit's thermometer; and it has been known so intense as to sink it to the freezing point of the purest mercury, viz. 39° below 0, or 71° below the congelation of water. The summer is short, but presents exactly the opposite extreme of winter; the former being, proportionably to its length, as hot as the winter is cold. The greatest heat, which is 85° of Fahrenheit, happens in July or August; and between this and the lowest summer heat, there is no less a difference than 46½ degrees. The westerly winds are to the easterly as 223 to 152; the former are more numerous in winter than in summer; the latter are the reverse. The barometer is in general comparatively low, being observed hitherto no higher than 28, 87, which station occurs in the winter.[†]

In short, as to the climate of the northern countries of Europe, where trees flourish on bleak and rugged hills, the year consists but of *two seasons*, viz. summer and winter; the former begins in May and ends in September; the other months of the year are winter, which, on its commencement, instantly binds the earth in one continued frost, shuts up the ports, and covers land and water with frozen snow, on which all manner of travelling is performed by means of sledges. During this season, the inhabitants dress in furs or skins, which, however, do not prevent the frequent loss of hands or feet, through the intenseness of the cold.[†] Now, what can

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[*] Edinburgh Transactions, Vol. II. Part. I. Art. XV. Kirwan's Estimate, Chap. X. page 61, 62.

[†] In a late publication (1802) by Sollenwerck, we are informed, that Siberia contains extensive forests, and produces apples; but,

can there be in the nature of the air, in Ireland, less friendly to vegetable life and the growth of trees, than the prolix and gelid intemperature of those regions?

Switzerland lies between 46° and 48° north latitude, and 6° and 11° east longitude. It extends, from west to east 260 miles, and from south to north 100 miles, making 12,884 square miles. On this occasion, we shall take, for example the canton of Berne, which is the largest, being almost one-third of the union. The city of Berne, the capital of the canton, is situated in lat. 47° N. and long. 70° 40° E. It is a large city, stands nearly in the centre of the canton, and is almost surrounded by the river Aar. It is encompassed with lakes and rivers on every side, except toward the north-east, in a direction to Schafhausen, where these latter barricades suffer an interruption; while the interior of the canton is freer from colossal mountains than any of the others. Together with six other considerable lakes, it contains the celebrated lake of Geneva, which is about 18 leagues long, and in its broadest part between 3 and 4 leagues.

As a specimen of the climate of Berne, we shall give a sketch of the seasons in 1766; in which the *winter*, beginning with January, was extremely severe.

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whilst this fruit possesses both the flavour and form, it is said not to exceed in size a common pea. Shall we then affirm, that forest trees and shrubs will not grow in a country, because fruit may be dwarfish, or sometimes blasted in it?

severe. The ice, on the lakes, was six inches thick; the esculent vegetables were frosted in most of the cellars, and even in deep holes dug in the earth for preserving them; the wine was congealed in many of the vaults; and the ground was frozen to the depth of three feet. Numerous vines, especially old ones, and even forest trees, were split by the severity of the frost. Great quantities of snow fell, and it was deeply frozen even in the vallies. The winds were chiefly north and north-east, rarely south or west. The grounds under autumnal crops of corn looked like a fallow, the blades being quite faded, especially in moist soils, though the weather was exceedingly dry.

In the beginning of *spring*, the lake of Bienne was so strongly frozen, thata carpenter built on it a spacious booth, in which he kept a fire. The vines suffered much; their buds fell off in powder with the slightest touch, and half of them perished. In the gardens, scarce a plant escaped the severity of the cold. Of all the fruit trees, the figs were most injured. In the pastures, free from ice, no verdure was to be seen, nor did they recover it until the end of April, when there were dews and mild rains. May throughout was cold and rainy, with frequent hail; and where the hail fell, it damaged the hemp and flax. Most of the bees died. The winds were north north-west and north-east.

Summer was not more favourable than the two preceding seasons; in the beginning, snow fell even in the lower mountains; and the weather continued cold and wet for two months. Meadows, especially wet ones, yielded but little hay, which was either spoiled by the rains, or swept away by the floods. The fruit fell off the trees in great quantities, and disappointed all hopes of plenty in this crop. The wheat crops were bad, and produced but little either in the barn or mill. The prevailing winds were north and west, which in some parts were so high as to break many branches off the vines. In August the heat and drought were so great as even to destroy a vast deal of fruit; and the garden plants were not only burnt up, but, where they escaped scorching, they were devoured by vermin.

In *Autumn* the gardens and fruits continued to decline; and, as might be expected, very little wine was made. In the beginning of the season there was a suffocating south wind, which was succeeded by northerly winds and hoar frosts. The last day of October there was a violent storm of wind, with a great fall of rain. Though November was remarkably dry, so dry that many springs of water failed entirely, yet there were several thick fogs. The same degree of drought continued in December, which occasioned many water mills to stand still for want of a stream to turn them. About the middle of this month, the snow began, and soon covered not only the mountains but the vallies.*

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* Meteoric. Obser. Econom. Society of Berne, 1766.

So extremely capricious is the weather in Switzerland, that it often renders travelling in that country very inconvenient. Amidst those regions of storm, the unsheltered traveller feels the full blast as it comes fresh from the aerial cavern; but no where is its violence so dangerous as on the lakes, which, enclose between lofty mountains, receive the strong currents of the tempestuous winds in their struggle through the narrow spaces, and suddenly raise their troubled water into foaming fury. These tempests, accompanied with lightning and thunder, sometimes burst on vessels in the middle of a lake, and involve them in dangers which are not easily escaped.

In this boisterous climate are *lofty mountains* clothed with a *luxuriancy* of trees, above which a bare and rugged peak often lifts its spiral head, as if to give a decisive effect to the magnificent and and picturesque scenery. In some parts, on the frowning brow of the rock, hang groves of pine, and firs bend majestically from the cliffs; while the graceful larch decorates the banks of the lakes, and far over the streams leaneth the weeping birch, mingling its long branches with the agitated waters. Yet, in several places, the mountains are stript of their arboreal clothing to a considerable extent, and, instead of dark green foliage, exhibit a rocky and gravelly waste, interspersed with wrecks of trees. This is the consequence of *avalanches*, which, with irresistible fury sweep away whole forests; nay, even

rocks,

rocks, coeval with time, often yield to those terrible instruments of devastation.

In other parts, instead of scenes of blended grace and majesty, the country assumes an aspect of savage wildness and terror. No pines wave their lofty heads, no mountain shrubs display their simple flowerets, nor does even a blade of weed betray the possibility of existence to any thing that breathes; winter seeming to have fixed in those situations its eternal abode, like that of Scythia, as represented by Virgil:

> ‘ Neque ullæ
> ‘ Aut herbæ campo apparent, aut arbore frondes:
> ‘ Sed jacet aggeribus niveis informis, et alto
> ‘ Terra gelu late, septemque assurgit in ulnas,
> ‘ Semper hyems, semper spirantes frigora Cauri.’
> Georg. Lib. III, v. 354.

> For there
> No grass the fields, no leaves the forests wear.
> The frozen earth, a hilly heap, below
> There seven cubits bury'd lies in snow:
> A wintry veil still hides the genial sky,
> And through the air stern westers ever fly.

In the extensive and admired vale of Urseren, there is *one* small forest of pine trees, which is preserved with a religious care, as a rampart against the *avalanches*. Where there is but one small forest, and this so scrupulously saved, there must of course be a great scarcity of wood, a production essentially needful to the inhabitants of so elevated a country, t only for shelter but for fuel. For the latter , the villagers bring up wood from the mountains,

tains beneath, which is done with vast labour and expense.

The majority of the vallies in Switzerland wears the same naked appearance; the soil occasionally gives way; the trees on the higher ground lose their footing and slide down; those trees which grow beneath them, being no longer sheltered, are torn up by the winds; and snow, which then accumulates without opposition on the heights, where the razed forests stood, melting at the return of spring, overwhelms the hills with torrents, dragging away the vegetable earth, and leaving the mountain a skeleton, unfit for pasturage; or, precipitating itself in the form of avalanches, it destroys every thing in its course.

Irreparable desolation is also caused by other phenomena, termed *lavanges*, which are of different descriptions. There are lavanges of *cold*, of *heat*, of *wind*, and of *dust;* each having some attribute of resemblance to the thing whence it derives its name; but all dreadfully destructive. Habitations, whole villages, are buried under them; forests are levelled with the ground; rocks yield to the shock, and are dragged on with the current. The air, agitated by the precipitation of the mass, carries devastation into places where the snow cannot touch; or the icy powder is scattered with prodigious impetuosity over a great extent of ground; a hurricane is less desperate in its effects; and sometimes even the traveller, who journies out of the reach of the lavanges, is thrown down headlong, or almost suffocated by the furious blasts loaded with particles of ice.* Hence it appears, that Switzerland is molested with a climate severe to a degree unknown in Ireland, yet that trees abound there in the meagre soil of very lofty rugged situations; but that, at the same time, if in that country a spot has been once robbed of its sylvan robes, it is a difficult task to restore to it those invaluable possessions.

* H. M. Williams' Tour in Switzerland, Chap. IV. X. XI. XIII. XVIII. XXI. Idem, Appendix.

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TO THE

INHABITANTS AND FRIENDS OF IRELAND.

AFTER a country, which once was covered with wood, has by great exertions been cleared, it is not an easy matter to convince the inhabitants of the necessity and advantages of that production, to get free from which so much pains have been taken. The return from planting being slower than from any other species of cultivation, and the person who sets, being seldom or never the same, who derives from it the most encouraging profit, we need not be surprized, that, in its advances, it should be the least rapid of any improvement, and that it should only be undertaken, when works of more immediate interest shall have been accomplished.

Trees are by many persons regarded as an embelishment, and embellishments seldom are contemplated, until a comparative degree of ease in pecuniary circumstances is experienced; when this is once obtained by industrious and successful cultivation, we may expect to see ornament attended to, and wood, the most prominent object in rural scenery,

nery, propagated with zeal and effect. Accordingly, in some districts of the kingdom, those farmers, who are in the best circumstances, are beginning to put down a few trees; and where the farms are small, a few trees on each would soon give a total change to the face of the country.

By persons of rank and fortune, indeed, a great deal of planting has been executed since the beginning of the 18th century; and it is pleasant to observe, that this rational and truly useful pursuit is daily gaining ground. How strong an incitement to it should be the reflection, that, whilst the proprietor is thus employed, he is improving his health, and adding to his fortune, instead of injuring the one, and wasting the other by indolence and by extravagance; at the same time he may have an additional pleasure from the reflection, that for each shilling laid out he increases the public stock twenty fold; a sentiment which every well regulated mind will naturally entertain and cultivate.

Notwithstanding the spirit of planting has gone forth amongst the higher classes in the land, unless it also pervade, in a certain degree, the *immediate occupiers*, the country *never* can have that aspect of cultivation, that richness of tint, which trees alone can impart. To contribute to this most desirable end, landlords should hold out encouragement to their tenants by supplying them with trees, and rewarding them for their preservation. The expense attending this would be proportionably small, and the profit would ultimately centre in the augmented value of the estate. At the same time, it must be confessed that there is a difficulty in carrying the proposal into execution. It can only be practised under certain limitations; for with those, whose sole object is an existence, it cannot be supposed that any minor consideration would operate upon them, nor that they could be induced to make and keep up fences for the preservation of trees, which they scarcely can be prevailed on to do for the protection of their crops of flax, grain, and potatoes. Every encouragement therefore, must be suggested by that sagacity, and directed by that prudence, without which neither public nor private measures can succeed.

Some instances, together with those already cited, might be found in Ireland, where proprietors of land wisely hold out the proposed encouragement. But the most striking example that I have met with, is set us in Scotland, by the magistrates of the borough of Perth, than whom few administrators of the revenues of an Incorporation have fulfilled their trust in a more commendable manner. They formed nurseries and plantations of trees on part of the town lands. When those nurseries and plantations were begun, the lands, as a source of income, were comparatively of small value. The nurseries alone, by supplying the highland counties with plants, now yield a great return of rent. The trees in the plantations have grown up, so as to produce, by the annual cuttings, a handsome revenue, and, at the same time, to form a noble and constantly improving capital, which the town may readily convert into a great sum of money, whenever it shall have to defray the expense of some grand undertaking of public utility.

A very judicious planter, in our own country, Mr. M'Evoy, of Tyrone, is decidedly of opinion that the great point, which ought first to engage public attention, is that of giving every kind of encouragement to nursery-men; confining them, however, to common articles, such as thorn quicks, oak, ash, beech, larch, firs, sycamore, and alder. Grand juries and farming societies, as well as the Dublin Society, might do something in this way. Were nurseries established in sufficient number, planting would go on rapidly; gentlemen would be induced to plant a hundred trees for one they do at present; and a principal impediment to the progress of planters of inferior descriptions would be removed, as they might resort to those establishments, without being at the expence of sending to distant parts. Men, who plant on a small scale, are not deterred by the price, but by the distance of carriage, by the hazard of suffering from bad packing, and by the chance of the plants being too long out of the ground. When planting, by those and other encouragements, would become general, no temptation would exist for stealing; it being a well-known fact, that, as an article grows plenty, the enticement to pilfer diminishes, in proportion to the encrease of the article.

It may be said, that planting is a work of time, and that it will gradually advance by individual exertion; but we should, on the other side, weigh the necessity of expediting the progress, as means of producing prodigious improvement, and as a measure for sharpening and preserving the edge of that instrument, *popular industry*, without which neither planting nor any other beneficial work, can be extensively pursued. Public assistance, private example, and local encouragement judiciously applied, certainly would shorten the process of clothing the country with an extensive foliage, and mature the undertaking sooner by a century, than if it were left to struggle under the circumstances with which it is at present burthened.

Plantations not only improve, but create a soil. By the annual fall of a great number of leaves, which the rains melt into the land, it is considerably improved; or where the ground is bare and rocky, this vegetable paste forms a soil. And it has been found, that when copses, in that situation, are stubbed up, the ground, however unfruitful before planting, has thereby been so enriched as to bear excellent crops for many years, without the additional help of manure. How much land-owners are interested in planting waste or barren spots, cannot be doubted; and surely nothing but a degree of indolence or ignorance, unpardonable

able, in these active and enlightened times, could occasion them to neglect it.

Wherever the country is bleak and bare, the plantation of trees in proper situations, will make it fitter for culture than it could otherwise prove; for the ground occupied with the trees, compensation will be made to the farmer, by the increased fertility of that which is around it, and thus would a two-fold advantage be gained. Besides, there are, in Ireland, numerous insulated heights, raths, and other spots of which the surface is too rugged, or the acclivities too steep to admit the use of the plough, which cannot be more beneficially cultivated than by covering them with trees.

Even the craggy cliffs of our highest mountains, unsusceptible of other improvements, would generally, with due pains, come to bear timber trees, or some of the hardier wild shrubs. If these steep cliffs were once covered with ligneous plants of any sort, vegetable mould, as before observed, would spring up, and we should acquire the means of turning those scenes, hitherto barren and disagreeable, to whatever purposes of cultivation might be judged the most eligible. There are few situations, in this country, in which the oak, the larch, the common fir, and the mountain ash might not be made, with a moderate degree of care and skill, to grow successfully. And where they would not thrive alone, they might be brought to do so by associating them with trees and shrubs of a different kind.

In planting on hills, the effects, which the shape of such grounds naturally has in respect to the admissible number of trees, should be taken into consideration. By experience and calculation it is found, that hills and mountainous grounds, though they measure twice as much as the plain surface on which they are incumbent, their produce cannot be more whether sown or planted. Suppose a hill contains four equal sides, which meet in a point at top, the contents of these four sides can yield no more grain, or bear no more trees than the area of the plain ground which sustains the base; although by the measure of the sides, they may be found to comprehend double the acreable extent of the base or ground plot. For as long as all plants preserve their upright method of growing, hilly grounds, which afford no greater atmosphere to the tops, can bear no greater number of plants than the plain underneath their respective bases. The same holds good with regard to buildings on those elevations; for the two sides of a hill will admit no more than the same number of houses than can stand in the line at the base. And as to railing or park-paling across a hill, though the measure over it be nearly double the line at the bottom, yet both may be enclosed by the same number of pales of the same breadth.

Another effect of elevation, namely, its effect on temperature, deserves notice. Land or earth, particularly if dry, receives heat from light very readily, but transmits, or conducts it, through its own substance, to great depths, very slowly. The greatest cold, even that which exceeds ° of Fahrenheit's scale, if it last only a few days, penetrates no deeper than 20 inches, when the earth is not protected by snow, and not above 10 inches, where snow lies on the surface. In Siberia, where the natural cold is known to be intense, immediately after the dissolution of the snow, the earth is found unfrozen, not only at its surface, but even to the depth of 16 feet. Stones, or sand, contain less specific fire than earth; this being always moister, hence they heat and cool more rapidly, and to a greater degree.

Lofty mountains, especially if their horrizontal surface be not very extensive, do not warm the atmosphere in any considerable measure; yet that part of it, which is in contact even with the loftiest mountains, is warmer, at least in winter, than air of the same height over plains. The reason of this is, that such immense masses of earth and stone, generally contain more heat than mere air; and the air, in contact with them, being on that account specifically lighter than the more distant air, this latter air of course moves toward the mountains, or the general current of the atmosphere flows to them with greater velocity; whence, clouds seem to be attracted by them, and winds are commonly more violent on high mountains than on plains.

The air thus accumulated on the sides of mountains, is at length forced over their summits; but, in ascending to a greater height than that at which it was impregnated with vapour, it is cooled, and consequently deposits this vapour, which thereby forms mists on the sides of the mountain; and, when the quantity of condensed vavour is copious, it warms the air to a considerable degree. On the other hand, the air forced over the mountain, being deprived of its vapour, and falling on the neighbouring plains, greedily absorbs the quantity of moisture it had lost, and thus produces a remarkable degree of cold. Hence it is apparent, that mountains, in as much as temperature is concerned, are not in their nature hostile to vegetable life, when taken in general; and in particular, with relation to the mountains of Ireland, whose tops are not chilled by durable snows, we may infer that the temperature of the air on them cannot be unfavourable to the growth of plants, whether of the ligneous or herbaceous kinds.

Instead of the above principles of planting being incompatible with the general improvement of the country by tillage and pasturage, they are abviously promotive of it. There is, likewise, no way by which a gentleman, whose estates lie in a country remote from his residence, and where the odvantages for other improvements are not obtained without difficulty, can so easily provide the means of wealth to his distant posterity as by planting.

The want of timber augments the expense of building, and of course enhances the rent of houses; it also increases the price of machinery, and of all implements in which wood is employed. Hence it operates as a discouragement to industry, and proves an obstacle to the progress of manufactures, amongst which the fundamental manufacture, tillage of the ground, suffers considerably. Moreover, the ſcarcity of timber will injure commerce by restraining the building ships, boats and other machines for water carriage; which has not only an ultimate, but an immediate bad effect on agriculture and other useful arts.

For some useful timber, it is said, we must always be indebted to foreign countries, as it cannot be raised here of a good enough quality to answer the purposes for which it is required. Fir, we are told must still be imported into Great Britain, as well as into Ireland, because even English grown firs, it seems, are of *little value*. But, were the question to be fairly examined, I am persuaded, it would appear that there are not, in fact, any natural bars against raising fir timber in either of these islands. Mr. Pontey, of Yorkshire, a late sensible writer, very conversant in practical planting, ascribes the inferiority of English firs to causes, which the people have it in their power to obviate. He justly condemns the man of science for contenting himself with the received idea of the unprofitableness of English grown firs; and considers the general principle of planting merely for shelter and ornament as erroneous and detrimental. He insists, that his countrymen, relying on superficial information, have neglected to cultivate in a proper manner an extremely useful article, and of which, though several species will grow very freely there, they annually import vast quantities, at an enormous expense. This, he maintains, might be avoided, if not entirely, at least in the greater part, by *a right cultivation* of English firs; and he is astonished, that a subject of the first importance should hitherto have met with so little attention.

Mr. Pontey admits, that there are few English-grown firs of sufficient scantling for the purposes of building, but this deficiency he imputes to prejudice, seconded by ignorance and indolence. Whereas the truth, he affirms, is quite otherwise, and that the scarcity in question is the consequence only of unfounded opinions. We cannot, says he, expect substantial timber in oak saplings, and it would be equally unreasonable to seek for it in fir poles. The same train of observation is applicable to Ireland, where physical qualifications are no less favourable to the object than in England, whilst moral causes, I am afraid, will have an equal, if not a greater, adverse operation.

As the difficulty of raising timber in a country once despoiled of its woods, should never be lost sight of, I shall here introduce a few remarks, in addition to what has been already said respecting America, in that particular. The consumption of wood, in all the settled parts of the United States, exceeds so much the annual growth, that strong exertions and persuasions are used to bring about the propagation of trees for ornament, shelter, fuel and timber. They advise raising forest trees from seed; and premiums are given for this purpose. Their timber is so defective in strength and durability, that they are anxious to devise means for improving it in these essential qualities, for which they propose *girdling*. They recommend, and it is coming into general practice, to regenerate trees by cutting down all the standing timber of a lot of woodland at once, and suffering all the young shoots, &c. to take an even start, and grow up together. Hence we may perceive, that, with all the advantages of the American climate with respect to vegetation and the growth of trees, the utmost care and skill are requisite to replenish the country with timber, when once it has been robbed of that treasure.—From this let *us* take a lesson!

Were we to begin from this present year, 1804, to plant our hilly and waste grounds, and to extend our other species of plantations, it is not romantic to pronounce, that, in the space of 50 or 60 years hence, the nakedness of our country would be respectably clothed, our domestic wants of timber would be largely supplied, our sister isle would partake of the advantages, and our internal resources, the natural and lasting support of a nation, would be proportionably augmented.

Nature has furnished us with plants, shrubs, and trees, adapted to every soil and situation in our island; and, as the laws of vegetation are now much better understood than formerly, it is a reproach to those whose practice does not keep pace with their knowledge in making the best use of nature's bounty. Let no man repine and say, '*the land is barren*;' for those spots, which so appear, owe that appearance to human neglect and laziness. Considerable tracts of the country, that are now *sheer wastes*, at once unprofitable to the owners and disgraceful to the community, might be rendered by industry and art, nearly as valuable as those that are occupied in the various departments of rural economy.

> '——————'Tis *art* and *toil*
> Gives *nature* value, multiplies her stores,
> Varies, improves, creates: 'tis *art* and *toil*
> Teaches her woody hills with fruits to shine,
> The pear and tasteful apple; decks with flow'rs
> And foodful pulse the fields, that often rise,
> Admiring to behold their furrows wave
> With yellow corn. What changes cannot *toil*,
> With patient *art*, effect?——————
>
> '——————Hence utility
> Through all conditions; hence the joys of health;
> Hence strength of arm, and clear judicious thought;
> Hence corn, and wine, and oil, and *all in life*
> *Delectable*.'

☞ An estimate of the value of the Flax Plant is reserved for the 5th Chapter, in which it can be embodied with more propriety and advantage, than if it were introduced here.

at all admitting certain trees into a plantation.' Mr. Marshall thinks the Scotch fir is one of the last trees that ought to engage the attention of the planter; and that it should be invariably excluded from every soil and situation in which any other timber tree can be made to flourish. The northern aspect of bleak and barren heights is the only situation in which it ought to be tolerated; and even there the Norway spruce and the larch will sometimes out-brave it. In better soils and milder situations, the wood of the Scotch fir is worthless, and its growth so licentious as to overrun every thing that grows in its immediate neighbourhood; which renders it wholly unfit to be associated with other timber-trees.

On the contrary, Mr. Pontey thinks so favourably of the Scotch fir, that he places it next to the larch, and prefers it to all other sorts of fir commonly cultivated in England. He owns that there may be exceptions; yet the other kinds, he asserts, never can be so serviceable to the forest planter; for they do not grow as freely in fertile soils, and are improper for bleak barren lands. He considers the red deal, imported from Petersburgh, the same kind with that which is called the Scotch fir; and the inferiority of the latter to the former, he ascribes merely to bad management.

As to the opinions of our statistical writers relative to the Scotch fir, the most common of the fir tribe in Ireland, they who notice it are generally in its favour. They consider it eligible on account tuations, and seasons. The means, therefore, for reconciling these apparent contradictions, are no less evident than the contradictions themselves, that is, to apply the precepts of each party to the soil, situation, and other local circumstances for which they seem intended by their authors, or to which they bear internal evidence of being best adapted. This shall be the object of the succeeding sections of this chapter, in the course of which, it is hoped, that the necessity and utility of such an assimilation will be made visible.

SECT. II.

Fences and Shelter.

FENCING the ground is one of the first measures to be taken into consideration; for, unless that be effectually done, the business, whether of *sowing* or of *planting*, will be lost labour; and, in raising a wood-land from seeds, it is necessary not only to fence against horses, cows, and sheep, but also against hares and rabbits, especially if these latter animals be numerous. To fence against the cattle a ditch, bank, and dwarf-paling, or a close stake-and-edder hedge, called in this country stake-and-race, may suffice; but against the rabbits, nothing less than *death* is effectual. Those great destroyers of young plantations, hares, may be drawn from devouring the plants by sowing liburnum, the young shoots of which they prefer before even firs. There is a species of paling, which is recommended both for protection and shelter to young plantations, till arrived at sufficient maturity. It consists of single stakes, placed close together, and thrust deep into the ground, which is done expeditiously, and, where the land is not stony, is made with little expense.

For shelter and protection also, when convenient, as wands, hurdles are recommended, if there be enough of earth to support the ends of the upright rods. The hurdles are by some preferred to hedges, because the former can be removed in summer, and the latter, when they become shelter, make the trees, in exposed situations, too tender. Shelter, by means of what nursery men call *closets*, that is, small squares enclosed by hedges, is sometimes provided; but judicious planters condemn it as a general practice. For many kinds of tender trees and plants, whilst *young*, this mode is necessary, but extremely prejudicial to hardy kinds that must make their way on bleak hills, as they are thus too much drawn, the bark becomes spongy and more susceptible of frost, and they are by no means able to stand exposure, especially if planted in the niggardly and erroneous method pursued by many planters, viz. setting them eight or ten feet assunder. At the same time, this reprehension is not meant to extend to *distant shelter* in nurseries, which is indispensably requisite. In large scopes of dry, hungry, shallow soil, almost covered with broom, furze, and other spontaneous products, closets through the native brushwood may be formed of different shapes and sizes, so as to contain from 10 to 30 plants, at about 3 feet apart, or nearer, but scarcely ever to exceed that distance.

In exhausted grounds, shelter is almost always to be created, which may be done by sowing broom and furze seeds in crooked or zig-zag lines, or, in what is sometimes preferable, patches, which break the violence of the winds most effectually. With respect to broom, the latter mode should be preferred, as it makes a showy appearance the second year, and, along with the shelter it affords, gives to the whole a warmth and cheerfulness throughout the year. With respect to furze seed, it does not answer to sow it for shelter through the plantations; but on the banks of ditches it should always be sown in preference to broom, on account of the great length of time it lasts when regularly cut. A quart, to 30 perches, may be scattered over the entire back of the ditch, so that one half may be cut whilst the other remains, by which management there never is a want of shelter.

It is a good general rule to enclose the lightest grounds and most exposed aspects first. Another good rule is, to enclose sometime before planting; and, where it is required by the state of the ground, it will likewise be adviseable to drain. If the enclosing and draining were done three seasons before planting, a useful alteration would be produced in the nature of the soil. To this end, draining will contribute powerfully; if furze seed be sown on the backs of the ditches, the growth will become good shelter in three years; and the stuff, cast out of the drains, will go a great way in the deepening the soil.

Stone walls, though they protect against tresspass, are liable to particular objections, in regard to their effects on the constitution of the plants which they cover. Walls, even built dry and loose, acting somewhat like closets or close nurseries, skreen the young trees too much, by hindering the equable access of air, without which plants will not grow up healthy and vigorous. Hence, when they overtop a wall, particularly in exposed situations, their functions, which were accommodated to a different modification of the atmosphere, are repressed by external causes, their leaves become morbidly irritable, their tops and branches grow distorted, and every tree in the place suffers according to its proximity to the wall.

In mountains and exposed situations, where the soil will admit of it, draining, shelter, and nourishment for the roots of the trees, may be obtained by making small ditches, straight, crooked, or in a winding course; always taking advantage of the situation and exposure; the more exposed, the nearer it is necessary to introduce the ditches, recollecting, at the same time, that they should not be brought so near as to act like closets.

In high situations, and still more certainly in low ones, where stones are convenient, an eligible method of fencing against cattle would be, to build piers of stone at certain distances, and secure the intervals with cross rails of wood, by which the objection applicable to entire stone walls would be set aside, and efficient fences would be established. Along the rails might be raised hedges, and about them hardy shrubs might be planted, whereby still greater protection would be obtained, and the vegetable atmosphere in the place would be proportionably improved. The ends of the rails may be preserved from rotting by charring them, or by incrusting them with a composition made of air-slacked lime, fine sand, and tar; instead of the lime, decomposed shells, or any carbonat of lime, will answer; and, if linseed oil be used in place of tar, the composition, thus altered, will be very suitable to coat the body of the nails for the same purpose of preservation.*

As hornbeam (*carpinus betulus*) makes very good hedges, and will thrive upon cold, waste, exposed hills, it may be useful to mention a method employed in Germany for applying to it those works. The husbandmen throw up a parapet of earth, with a fosse or ditch on each side, and set hornbeam in such a manner, that every two plants may be brought to intersect each other in the form of a *St. Andrew's*

Cross.

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* As larches are seldom materially hurt by any other than the west and north winds, they are to be skreened by skirtings of Scotch Fir. Pontey's Profitable Planter, p. 40; from which to page 44 are rules for shelter-planting, age of trees, &c.

SECT. III.

Soil, Situation, Seminary, and Nursery.

> ———————————— Every soil
> " And clime, ev'n every tree and herb, receives
> " Its habitant peculiar; each to each,
> " The Great Invisible, and each to all,
> " Through earth, and sea, and air, harmonious suits."
>
> DYER.

EACH kind of native tree generally requires a peculiar soil and situation. The *oak* loves hilly better than boggy ground; but it makes the greatest progress in a deep rich loam.* Though *ash* will grow almost in any soil, yet its timber will be more valuable when produced in some soils than it will be in others. Thus in damp meadows, or moorish soils, it becomes light, spongy, and brittle, whilst on dry hearty spots its quality is of the opposite description. *Beech* delights in chalky or stony ground, yet it may be raised almost any where. *Larch* grows better on cold meager, gravelly, and stony lands than in a rich moist soil, provided that in the former the roots can find some depth to penetrate downward. *Alder* flourishes

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* Loam being a species of compound earth, respecting whose signification the public entertains very confused notions, it seems necessary to cite a definition given of it by one of the best judges in these matters, Miller, viz. " A sort of earth which is fat and slippery, not of so close a texture as clay, nor too loose and sandy, but of a middle nature between them, and is easily dissolved by frost, and gentle or easy to be wrought.' Hence may readily be conceived what in agriculture is meant by *clayey* loam, *sandy* loam, and *gravelly* loam

[illegible] in low marshy situations; but will not live [illegible] sandy soil.

[illegible] of the same family sometimes court [illegible] denominations of soil. Thus the *wild pine* [illegible] best in poor ground, on the north and [illegible] sides of hills; whilst the *silver fir* requires a dry, [illegible] soil, and shelter from the north wind. The *Levant cypress* likes a warm, sandy, or gravelly soil; and the *Virginian cypress* grows naturally in swamps, or where water covers the ground three or four feet.*

Trees having these natural propensities, they should be considered in the preparation of the ground, which, in every point of view, is an object of the first importance. On worn-out grounds nothing more is necessary than to enclose and plant; as trenching and ploughing would only serve to render the soil lighter, which is the chief fault of these grounds. To increase the depth of thin, wet, spouty soils, which generally are exposed in situation, forming ridges and furrows, is an advantageous method, which will at the same time drain the land; and planting potatoes is a good preparative to assist in expediting the growth of trees.

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* "Nec vero terræ ferre omnes omnia possunt,
"Fluminibus Salices, crassisque paludibus Alni
"Nascuntur, steriles saxonis montibus Orni;
"Litora Myrtetis lætiſſima, denique apertos
"Bacchus amat colles, aquilonem et frigora Taxi."
VIRG. GEORG. LIB. II. v. 109.

"Not every soil each varying race supplies,
"Willows by streams, in marshes alders rise;
"Wild ashes wave bleak promontories o'er,
"Gay myrtles blossom on the sea-beat shore;
"Along the sunny uplands vineyards glow,
"And yews ascend 'midst tempests wing'd with snow."
SOTHEBY.

To prepare healthy soils, Mr. Pontey recommends casting up the land in intersected trenches, in a serpentine form, by which will be avoided the appearance of regular rows, and the passage of winds among the trees will be prevented. In clayey situations, the first thing he advises to be done is, to render them dry by means of open ditches, and afterwards, instead of making holes, to get a quantity of soil from the nearest convenient situation, for raising hillocks, so as to plant the trees on the surface of the ground.

Soils that come within the power of the plough, may be trenched with the Kentish wheel-plough, drawn by oxen in the yoke fashion. This kind of preparation may, in some places, not only answer the purpose of opening the globe, but also of discovering a number of stones, of which the ground may thus be cleared, and convenient materials obtained for fences. The ground of a hang, too steep to be cultivated conveniently with this plough or one in common use, should be fallowed, and brought into proper tilth by the *turn-wrest* or *turn-wrist* plough, that is, one whose mould-board turns, so as to enable it to make good work on its return, and still lay the furrow down the hill. Where hangs are so very steep that even this kind of plough cannot be used with safety in preparing the soil, seedling plants may be put in without any previous preparation, except that of clearing away rubbish, and burning off the weeds and rough grass, with which the face of the ground may be overspread.

Every planter should have a *seminary* and a *nursery* of his own; for which, light, mellow soil, wherein the generality of tree seeds and plants can be successfully reared, is the most eligible. The great advantages derivable from making those provisions, especially in extensive systems of planting, have been fully experienced in this country. In the commencement of the valuable improvements, at Rash, county of Tyrone, vast quantities of seedlings were ordered from Scotland and other parts. This was done with the view of gaining two seasons, as it was supposed, that, for planting out to stand, those bought plants would come round two years sooner than those raised seeds sown at the same time that the seedlings were ordered. In some instances, this precaution answered; but, in general, the seedlings, raised upon the spot, proved vastly superior to any of those imported; and, in 1802, there was no comparison at all between the growth of the seedlings got from Scotch and English nurseries, (generally two years old,) and that of plants raised on the spot from the seed, notwithstanding the difference of two years in point of age. So that, it is much better to wait patiently for the regular capacity of the plants on the premises.*

What is here advanced applies principally to seedlings imported from Scotland and the North of England. For it is not to be hence understood, that, in point of time, there could be any material loss sustained by purchasing seedlings from Irish nurseries, when situated at a reasonable distance, and the proper measures taken in regard to packing, dispatch, &c. From long experience, Mr. M'Evoy knows, that, between these and plants raised from seed in the planter's nursery, very little difference will be found, provided the qualities of both are equal.

According to Miller, nurseries, for large plantations, should not be confined to any particular spot. In his opinion, it would be wrong to continue raising trees any number of years upon the same piece of ground, because by doing so the ground will be so much exhausted, as to render it unfit for the purpose. Where there is a sufficient scope, therefore, he advises to make nurseries upon the ground that is intended for planting, in which a competent number of the young trees may be left standing, after the others stocked; so that by letting the plants remain two seasons in the nursery, there will always be a yearly supply of 20,000; but this must be understood of gentlemen's nurseries, who may be supposed not scarce of ground; for it is quite otherwise with nurserymen, who commonly overstock their nurseries, and consequently the plants are too much drawn up, or grow too slender, for want of space.*

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* "At si quos haud ulla viros vigilantia fugit;
"Ante locum similem exquirunt, ubi prima paretur
"Arboribus seges, et quo mox digesta feratur:
"Mutatem ignodant subito ne semina matrem?"
VIRGIL GEORG. LIB. II. v. 265.

"Some planters, taking the minutest care,
"Of the same soil their nursery prepare,
"With that of their plantation; lest the tree
"Translated, should not with the soil agree.

These are some of the general observations to be made on the branches of the subject contained in this section; and now we shall proceed to mention briefly the management in particular cases, in respect only to the principal species of trees, viz. 1. *oak*, 2. *ash*, 3. *elm*, 4. *fir*, 5. *larch*, 6. *beech*, and 7. *sycamore*;† by which also some idea may be acquired concerning the proper treatment of some other kinds.

To propagate the *oak* from seed, Miller advises the acorn to be sown early in November, in drills about

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Ireland, is 21 feet; in England, it is in general 16½ feet; except in measuring fen and wood land, when 18 feet are allowed, and 21 feet in forest lands. In England also, eighteen score perches are given to an acre of flax; but with us, ground under flax and that under every other croſs are measured by the one stated rule.

[*] 7. Tyrone Survey, page 180. Append. page 2, 60. Pontey, page 49, 56. Hayes page 7. Miller, Art. Nursery.

[†] 1. *Quercus Robur*. Lin. Claſs VIII. Octandria, eight Stamens or Chives. Order IV. Tetragynia, four Pistils or Pointals. 2. *Fraxinus Excelsior*. Class II. Diandria, two Stamens. Order I. Monogynia, one Pistil. 3. *Ulmus Campestris*, Claſs V. Pentandria, five Stamens. Order II. Digynia, two Pistils. 4. *Pinus Rubra*. Class XVI. Monodelphia, one Brotherhood. Order III. Polyandria, many Stamens. Withering, Wade, Hayes, and Fortescue denominate this *Pinus Sylvestris*; Miller, Pontey, and others name it as above, *Pinus Rubra*, which

about 4 feet asunder, and two inches deep, into which the acorns should be deposited at two inches distance between each. About the middle of April the young plants will appear above ground, which should be early cleaned of weeds, and the cleaning should be repeated as often as the weeds re-appear.

After the plants have grown two years, it will be proper to draw out some of them, where they grow too close, leaving them at this first thinning about one foot asunder. In two or three years more, they may undergo another thinning, and then left at about four feet apart, by which they will have room enough to grow three or four years longer. When the plants have been reduced to the distance of about eight feet, they will not require any more thinning. But in the space of two or three years, those which are not to remain will be fit to cut down, to make stools for underwood; and those which are to remain will have made such progress as to become shelter to each other. The distance that Miller allows between those trees designed to remain for timber is, from 25 to 30 feet, which will not be too near, where the trees thrive well.

Other

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which appears to be its right appellation, as it agrees in quality with the timber of this tree imported from the North of Europe. The *Pinus Sylvestris* is the Wild Pine or Pinaster, or the Cluster Pine of Dr. Wade. The Pinaster is by some denominated *Pinus Cembra*, which by Dr. Wade is called Siberian stone-pine. 5. *Pinus Larix*, a species of the *Pinus*, and therefore of the same Class and Order with the *Pinus Rubra*. 6. *Fagus Sylvatica*. Class XI. Dodecandria, twelve stamens. Order III. Trigynia, three Pistils. 7. *Acer Pseudo-platanus* class with the *Quercus*, and Order I. Monogonia, one Pistil.

Other methods of increasing the oak from the seed have been recommended. It is proposed to turn sods upside down, at three feet distance, and to plant one or two acorns in each sod with a dibble, thinning the trees at 10, 15, 25, 35, and 45 years growth, leaving at last 75 trees upon an acre. In some countries plantations of it are made by sowing acorns with wheat, after a summer fallow; in other countries again, it is recommended to plant the acorns under bushes, which would protect the young plants, till they would arrive above the bite of cattle.

Oaks raised from the acorn, without removing, grow slowly, but when they arrive to the state of timber they are the best, being generally fuller at heart, and more compact, strong and lasting. The reason given for this slow growth is, that the tap root strikes down into the ground, where it is likely to meet with less nourishment, than if the tap had been shortened, and horizontal shoots emitted. If oak plants of one or two years growth be stunted or crooked, after they have taken the ground, they are frequently cut off a little above the surface; and the second shoot being found to grow with greater luxuriance than the first, is trusted to for becoming a tree.

The *ash* tree is increased from seeds or *keys*, which should be buried one year in beds or pots of sand before they are sown. It will also propagate itself in plenty by the keys which fall in autumn, provided they fall in places to which cattle have not access; at least in this way enough of plants may be obtained in spring for small purposes. But if a large quantity of trees is to be raised, the keys should be buried as above mentioned, or the seeds should be sown as soon as ripe, and the plants will appear the following spring; whereas, if the seeds are kept out of the ground till the spring, the plants will not come up until the succeeding year. The ground, therefore, in which they are inserted, should be kept clean the whole summer, and not disturbed, lest the seeds might be turned out of it, or buried too deep to grow; which is a necessary caution, because many persons are too impatient, to wait a year for the growth of seeds, in so much so, that if they do not come up the first year, they dig the ground and thereby destroy the seeds.

If the plants make a good progress in the seminary, and are kept clean from weeds during the summer, they will be fit to transplant again autumn; consequently in the nursery, ground ought to be prepared to receive them, and as soon as their leaves begin to fall, they may be transplanted. In taking them up, care should be taken not to break or tear off their roots; to prevent which they should be cautiously raised with a spade, and not drawn out, as frequently is practised. Many of the plants which rise from seeds, will outstrip the others in their growth, and the largest often are extracted, whilst the smaller are left to grow a year longer, before they are removed; and, to avoid hurting those that are left, the others are drawn out by hand, whence many of their roots are torn off or broken. It is therefore a much better way to take up all, little and big together, and transplant them in rows, placing each size by itself.

The rows should be three feet asunder, and each plant at a foot and a half distance. In this nursery they may remain two years, again which time they will be strong enough to plant where they are to continue; for the younger they are planted out, the larger they will grow. Hence, where it is wished that they should grow large, they ought to be planted very young; and the ground where the plants are reared, should not be better than that wherein they are designed to become trees, because when they are propagated in good land, and afterward transferred into worse, they very rarely thrive; so that it is much the best method to make the nursery upon a part of the same land, intended to appropriate to plantations, and on it may be left standing a sufficient number of plants, which by this measure will surpass those that are removed.

Miller recommends to propagate *elm* by layers, rather than by suckers from old trees. The best soil for the nursery is a fresh hazel (light brown) loam, neither too light and dry, nor over moist and heavy; this ground should be well trenched, and it will be of service to bury in it a little rotten dung. The best season for this work is autumn, as soon as the leaves begin to decay, that the plants may take root before the dry weather comes on in spring. Here they should be permitted to grow rude two years, during which time the ground between ought to be carefully cleaned and dug every spring. At the end of that period they will be well rooted, and will have made pretty strong shoots, so that they may then be laid in the ground. When these layers have acquired sufficient roots, which will be in one year, they ought to be taken off and transplanted into a nursery, which should consist of a good soil, and be well prepared. In this nursery they may remain four or five years, observing every spring to dig the ground between them, to clean it in summer from weeds, and in autumn to trim the plants; by which means they will be strong enough to remove to their standing situation.

Not only in this manner, but even from *chips* elm may be increased as follows: when elm timber is felled in the spring, let the chips made in trimming or hewing the fresh trees, be sown like corn on a piece of newly ploughed ground, and let them be covered in by the harrow. Every chip which has an eye or bud-knot and some bark on it, will soon shoot like the cuttings of potatoes; and the plants thus raised having no tap-roots, but emitting their fibres horizontally in the richest part of the soil, will be more vigorous and may be more easily and safely transplanted, than when raised by any other method. They are likewise better calculated for hedges than others, and, if those hedges be kept clipt for three or four years, they will be almost impenetrable.

Scotch fir is propagated by seed, which is procured by exposing the cone to a gentle heat, or by soaking it for twelve hours in warm water. To plant these seeds the following method is recommended; make two cuts with a spade thus >, the angle of which being raised, put the seed under it, from one to two inches deep, and then press down the sod. If the ground be stony, a dibble may be used; and if it be moss or clay, which is apt to shrink with drought, an instrument like a gouge or a borer, is used to form a round hole. Having been transplanted out of the seminary into the nursery, the plants should not exceed four years old when they are removed to stand. The wood of this tree, naturally sown, is reckoned greatly superior to that of transplanted trees, and is extremely durable.

The *larch* is a native of the Alps and Pyrennees, and about 140 years ago, was found in the collections of the curious in England. Some time before the year 1768, when the 8th edition of Miller's Dictionary was published, this tree was very much cultivated in England; and though it had been introduced into Ireland prior to that time, its culture here was but circumscribed, until within these twenty or thirty years past.

The larch is raised from seeds, which should be sown on a border exposed to the east, where the morning sun only shines on it; or if they be sown on a bed more exposed to the sun, they should be skreened with mats from the mid-day heat; for when the plants first appear above ground, they are very impatient of heat; and when the bed is much subjected to the solar influence, the surface of the ground, in some seasons, will dry so fast, as to require frequent watering, which is apt to rot the tender stems of the plants. This will be obviated by shading them while young, and afterward they will not be in any danger. Some persons, instead of sowing single seeds, recommend to bury a whole cone at a depth of three inches. And not only in these ways may this tree be propagated, but also by young shoots which spring from old decayed stumps.

If the seedlings have made good progress in the seminary, they may be removed into the nursery the following autumn; otherwise, they may continue in the seed-bed another year, especially if they are not too close to each other. When they are removed, it should be done in the autumn as soon as their leaves decay; and they may be inserted into the beds about six inches asunder each way, which will be distance enough for their growth the two following years, again which time they will be fit to transplant where they are to be stationary.*

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* When treating of the larch, Miller recommends nurseries to be made near the place intended to raise this tree for timber; and, as a frugal method to keep these nurseries clean, as well as for the work

The *beech* is propagated by sowing the seed or *Mast* as soon as it is ripe, from October to February. A small spot of ground will be sufficient for raising a considerable number of plants; one bushel and a half, at the rate of three bushels to an acre, will produce 150,000 young plants, in a favourable season. Great care must be taken to keep them clear of weeds; and, as they generally come up thick, the strongest ought to be drawn out the succeeding autumn. When removed into a nursery, if intended for timber trees, they should be planted in rows, at three feet distance each row, and one and a half for each plant; but if designed for hedges, (to which the tree is very well adapted,) the distances may be a third less; and in this nursery they may remain two years.

Sycamore is easily propagated by sowing its *keys* or seeds; which should be done soon after they are ripe, in a bed of common earth, covering them about half an inch thick with mould. The ensuing spring, they will appear above ground; and, if kept clear from

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work of transplantation, he advises: "If there are any poor cottagers there, these may be employed in raising of the plants, "keeping of them clean, and afterward in transplanting them. This "will lessen the number of indigent poor, and by employing them "in this sort of husbandry, they may be brought to have a love and "regard for trees of their own planting, so will not be tempted to "destroy them themselves, or suffer others to do it; and as the "season for planting happens at a time of the year when farmers "have little employment for their labourers, so the finding them "useful employment this way, will be of infinitely more advantage "than the giving them alms from the parish; and the children may "be taught to weed and keep the young plants clean in summer, "whereby they may be rendered useful, and kept from being burdensome to the parishes."

adduces the authority of Miller in favour of sowing the acorns, where the oaks are intended to be permanent; "for those which are transplanted will never arrive to the size of those which stand where "they are sown, nor will they last near so long "sound."*

At the time of transplantation, where there is a long stubborn tap-root, which might be expected to prevent the tree from settling well in the ground, instead of cutting off the tap, as generally practised, Mr. Hayes recommends nicking it half through, which affords an opportunity of bending it horizontally, whence it will throw out strong shoots both from its extremity, and from the spot immediately above the incision. When the extremities of the roots are bruised, the direction of the cut in removing the injured portions, is material; but for the most part, the less the root is pruned the better.

If in particular the tap-root of the oak be cut off, two or three tap-roots will generally be produced in its place, which will fit the plant better for finding out the good earth; and in case one root meets with an obstacle, the others may be more fortunate in their progress. But if the tap-root be suffered to remain, some people advise, in order to plant those trees without injury, to bore holes for them with an iron instrument, such as is used for fixing hop-poles. On the contrary, Miller is decidedly against this expedient, as it is setting the trees in a sort of tub, where there will be little room for their roots to extend; and wherein too much wet will be retained, which will occasion them to decline and die. If the ground be hard rock or gravel, he assures us, that it will be vastly better to raise a hillock of earth where each plant is to be set, than to dig into those substances and fill the holes with earth, as is too often practised. Having planted the trees, if the ground admit it, they will be more effectually secured against high winds by fastening them to stakes; and it will assist their growth to lay some mulch or dung on the surface about their roots. In fact, it will be vain to attempt the removal of a tap-rooted plant, especially the oak, which has not previously undergone the operation; and not less difficult will it be to make a weak rooted plant of any kind, (the aquatic excepted,) succeed with a large top on it.

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* With respect to a method of putting down acorns, and a reason for the greater durability of oak timber thus raised, see the preceding Section.

" Too much care," says Mr. Hayes, " cannot be " taken to prevent the effects of drying winds and " frost on the roots of trees, at the time of taking " up and transplanting; a tub of water, thickened " with earth to the consistence of cream, should be " ready to receive *seedling plants** by all means, and most others, in general as they are taken up; and close boxed carts should be prepared for larger trees, in which they may be placed *perpendicularly* on the bottom of their roots; many trees are spoiled by carrying them horizontally." Besides, in making a large plantation, the more able hands the better; and much depends on the method of arranging the workmen, who are best divided into *takers-up*, *pruners*, *carriers*, and *planters*, to whom respectively belong duties, on the faithful discharge of which, rests the success of the plantation.

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* To designate young trees which have been removed from the seminary into the nursery, and thence transplanted to remain, since no term appears to have been yet introduced into the art of planting, it seems consistent with the scope of this work to supply the planter's vocabulary with a name for this purpose, which I would propose to be *Weanlings*, on the principle that this term corresponds with the word seedlings in the source whence the latter is derived, and with the spirit of its meaning.

With respect to season, in stormy situations, Mr. Hayes prefers planting in spring; but trees planted at this time will require more watering. In general, it may be observed, that all the deciduous trees may be planted in any month between October and their time of shooting into leaf. In such situations, and in thin soils, Mr. M‘Evoy almost universally practised spring planting, having found from experience, that those aspects and soils were not calculated for autumnal planting. Mr. Dutton also, who is very good authority on this subject, informs us, that in exposed places, all deciduous trees are more safely planted in February and March; oak and larch when they just begin to bud; whilst ever greens never should be planted in those or in any other situations, sooner than the middle of April, and in rigorous springs, the middle or end of May is preferable.

The greatest objection, according to Mr. Pontey, against spring planting, is the frequent failure of the plants for want of sufficient moisture, particularly if they have been some weeks out of the ground. To guard against the effects of drought, and as a remedy for trees in some degree injured by it, he proposes a very simple and cheap process, termed *puddling*, which is performed thus: as the trees are taken up, a person cuts a hole in the ground, and pours into it a quantity of water; he then works the soil with a spade to such a consistency, that when the trees are dipt into it, a considerable quantity will stick to their roots: another person having taken off the extremities of the roots, keeps dipping them in small quantities; after which they are bound together in bundles of two or three hundreds each, according to size, and conveyed to where they are wanted. Then, placing them together in an upright position, in any situation that is sheltered, straw is carefully put round the outsides, to keep the air from drying their roots. Where the situation affords means, the bundles should be dipped in water before they are unbound, as the outside plants will be somewhat more dry than the rest; but this may be dispensed with, where proper care has been taken in the preceding steps of the business.

Mr. M'Evoy discovered a species of planting which he denominates *cluster-planting*, and which he found remarkably advantageous in exposed situations.

tions. A number of seedling plants were taken up in clusters, and each cluster, containing from four to eight plants, was set about nine inches asunder, some promiscuously, and some in lines. The consequence of this manner of planting was, that in three years it made a fuller figure in those situations, than planting in the common way had done in five years. In such situations what we want is, to cover the surface as soon as possible, and, of course, create shelter; for both which purposes this method is extremely well calculated. The mode here recommended has this further advantage over the common one, namely, that the plants being balanced from the surface several years, the wind has little or no power of disturbing them.

But the most universal system of planting at Rash, in mountainous and exposed situations, was pursued according to the following plan. Three principal objects were in view, namely, draining the soil, creating shelter, and securing a sufficiency of earth to nourish the trees. To answer these purposes, small ditches were made in the manner recommended in the 2nd. section of this chapter. For the permanent timber, on these occasions, oak, ash, and sycamore were chiefly preferred; beech was sometimes introduced; and great quantities of mountain-ash, alder, birch, poplar, &c. were inserted in strong bodies between the valuable plants. Instead of planting alternately, the different kinds were entered in groupes; two or three oaks, three to six ash, and two or three sycamores in each group; and according to the nature of the soil, each species was varied except the oak, which was universal. The reason given for the sparing use of the beech is, that this tree, when put into the faces of ditches, does not bear cutting so well as oak, ash, and sycamore.

This is the most beneficial system of mountain planting known to Mr. M'Evoy; for merely by cutting away inferior and hurtful stuff, each acre will return £.20 in 15 years; and the necessary thinning of the principal timber, that of ash alone, will produce a great additional profit. The picturesque effect, also, of this system being signal and expeditious, will recommend it to persons of taste, who always consider the scenic disposition of their improvements.

By many observations, Mr. Templeton is convinced, that it is the wind alone which prevents the the growth of trees on the shores of the sea in Ireland; and that, on a large plain, where the winds are not impeded in their course, a difficulty in raising plantations will be experienced, equal to what is found on the verge of the ocean. In order, therefore, to produce a plantation near the sea, on a low shore, it is necessary to commence the planting at a considerable distance from the coast, and to allow the young trees to have behind them others several feet taller than themselves, which will have the same protecting effect as high land. For by means

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of the opposition, which a multiplicity of stems and innumerable branches present to the wind, its force will be greatly lessened, as we find by standing on the windward side of a thick wood during a storm, where, if the trees are lofty, the wind is much less violent than on an open plain. Hence we have a rule for creating shelter on windy heights, as well as on bare flat grounds. And here we have room for remarking, that the above impediment to the growth of trees, without due investigation, might be adduced as an instance in favour of the opinion, that our climate has undergone a recent and serious alteration; whereas, that impediment is manifestly owing to an invariable natural cause, whose injurious effects may be obviated by the judicious application of art.

On exposed ground, Mr. Templeton advises to make the first plantations with such trees as are natives of mountains, which are by nature fitted to bear the rude blasts of winter, and by the stiffness of their leaves, or flexibility of the footstalks, to remain unhurt by a summer storm; of which description are the various race of pines, the birch, the aspen, and the mountain-ash; especially the two latter, which he found, as already observed, growing luxuriantly in very elevated and stormy situations.

In those kind of situations, Mr. Dutton contends, that trees should not be planted more than 18 inches asunder, and that they should not be more than three or four years old. By these means will be constituted a nursery, from which, in a very short time, as many trees may be drawn as will plant more than the same space of ground; for the young trees should just touch each other, not intertwine their branches, before they are removed. If they are not to be planted again, the branches of those that are *not to stand*, should be gradually cut away as fast as they interfere, by which measure a great deal of valuable winter food for cattle will be obtained from the trimmings, and the trees will still be increasing in value. This operation should be continued whilst necessary, and when those that are lopped can stand no longer, they should be cut down, and probably again this time will be fit for many country uses. The browse procured by these thinnings has been estimated at the value of from *£*.49 to *£*.98 per Irish acre.

Where the exposure of the place would render trees liable to be shaken in the ordinary mode of planting, experienced planters have long reckoned it a good method to lay the deciduous kind slanting on the turf or sod, turned over as usually done in marking out quickset fences, covering the plants with the next spade of soil, and sloping the bank which is laid over them, down to the next row, in order to conduct the rain to the roots. The rows should stand so as to give the young plants the most effectual shelter, and the heads of the sets should be cut off at the time of planting, as done in thorn quicks; from whose free growth, whence thus managed, the practice here recommended may be adopted with safety.

Even in drifting sands, skilful planters are able to raise trees. Vast tracts of this description of ground have been planted in the county of Norfolk. The sand was of so light a texture that it was carried about by every wind; and, in many places, it was so loose that no grass would grow upon it. Art and industry, however, brought that once Arabian Desert, as it was termed, in the space of thirty years, to wear a different appearance; and most of those tracts were either clothed with plantations, or rendered very good corn-land and sheep-walks.

The undertaking was commenced by sowing the sides of the sand-hills with the seeds of French furze, which grew so fast that once in three or four years they were cut for fuel, and sold at a good price. This excited some public spirited gentlemen to attempt planting Scotch and Spruce firs, and other hardy forest trees; in which they succeeded beyond expectation, by raising marle that lay beneath the sand, and incorporating these two substances in the holes where the young trees were inserted. By this expedient, the soil became fixed, and soon covered with grass and other herbage; and hence vast plantations of forest trees, in the most healthy and vigorous state, arose, where some

year

years before, ten acres of land would not maintain a single sheep three months.

Nay, trees can be reared on sandy ground, where the premises do not afford marle. Plants are chosen that are no higher than barely to escape being covered with the drifts; the holes are made at planting; a cart of mould with one of water attend the operation; and, when the holes are half filled over the roots, some water is to be poured on, throwing in the remainder of the earth and sand. The plants adapted to this soil, are oak, beech, larch, Spanish chesnut, Weymouth pine, and all sorts of fir, (the Scotch excepted,) together with some inferior sorts for the purpose of shelter, amongst which the birch, is most prized. Though a driving sand seems the least likely of any soil to gratify the planter's wishes, there are several other instances, besides those in Norfork, of its having produced a great growth of timber, viz. the very successful and extensive plantations of the Duke of Portland, at Welbeck Abbey, Nottinghamshire; and those at Bagshot, Surry, belonging to the late Duke of Cumberland.

Means are not wanting to prevent the drifting of loose sands, and thus to prepare them for the support of trees. This may be effected by various kinds of reed, viz. the common reed grass *(arundo phragmites,)* the sea reed grass *(arundo arenaria,)* and meadow-reed grass *(poa aquatica.)* For this purpose the sea-reed seems designed by nature, as it grows in the driest sand upon the shore. Where this reed is wanting, many a fertile acre has been covered with unprofitable sand, and rendered entirely useless, which might have been prevented by sowing the seeds of this plant on the shore, as is now done on the flat coasts, in Norfolk, to repel the sea.

Queen Elizabeth wisely prohibited the extripation of this plant, in order to prevent the misfortunes which have since happened in England, where considerable districts have been overwhemed by those unstable sands, driven by boisterous gales. Had a similar prudent foresight been directed toward Ireland, the like catastrophes would not have occurred in the counties of Donegall and Wexford, and Dr. Hamilton would not have had the sandy inundations of Rosapenna and Bannow to prop his hypothesis respecting the altered nature of the climate of this country.

The Dutch sow matgrass *(nardus stricta)* on their sand-banks, that the sand may not overspread the neighbouring parts; and we are informed, that land has been gained on the coast of Holland by fixing rows of straw wisps, or of faggots of heath, upright in the sand, about a foot distance from each other; or by setting stakes at proper intervals, and platting straw bands between them. Or the platting might be performed either with heath, or with bands made with some of the bent grasses, or with the mountain rope-grass *(melica nutans.)* The natural qualities of the latter seem to render it peculiarly fit for this purpose; with it ropes are manufactured for fishing nets, which are remarkable for lasting long without rotting. To the same end, also, a grass, by the Spaniards called Sparto, *(stipa tenacissima)* appears to be signally adapted, needs no preparation for working, and with it they make baskets, shoes, mats, cables, and durable ropes, which require not to be tarred. It grows on sand-hills; and probably would thrive extremely well on these sort of places in Ireland. Our sea lime-grass *(elymus arenaria,)* might perhaps answer in its stead; and to the same use rushes might be applied.

As to boggy ground, at Willsborough, county of Derry, Mr. Scott plants with great success, in what is called a *quick moss,* thus: in the bog a round pit is dug, which is filled with vegetable earth, or with fertile clay. The plants being rooted in this, no further care is necessary, except that of keeping them from shaking by occasionally pressing down the ground after high winds. If oak and beech are planted, earth or clay need not be added; whilst ash and sycamore require a mixture of soils. Larch, silver firs, spruce, alder, and birch are mingled with other trees, in very promising and extensive plantations. Where the peat is not so deep as at Willsborough, for instance at Kilderry, General Hart's method of planting young trees, already described, will be found easy, expeditious, and effectual.[*]

Trees should be transplanted, in relation to the cardinal points, just as they previously stood, that is, the side which, in the first station, faced the south, ought to be placed again in the same direction; as a guide to which, the bark should be marked before the tree be moved.[†] Frequent transplanting trees while young occasions their roots to grow so strong, that, when put into plantations for remaining, they seldom or never fail; a fact which evidently merits special attention in planting all exposed grounds. Another

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——[*] ‘ Much may be perform'd, to check the force
‘ Of nature's rigour: the high heath, by trees
‘ Warm-shelter'd, may deſpiſe the rage of storms:
‘ Moors, bogs, and weeping fens, may learn to smile,
‘ And leave in dykes their soon-forgotten tears.
‘ Labour and Art will every aim achieve.
‘ Of noble bosoms.’——————

‘ [†] Quin etiam cœli regionem in cortice signant:
‘ Ut, quo quæque modo steterit, qua parte calores
‘ Austrinos tulerit, quæ terga obverterit axi,
‘ Restituant. Adeo in teneris consuescere multum est.’
Virg. Georg. Lib. II. v. 269.

To set the plant just as it stood, they mark
The heav'n's four quarters slightly in the bark;
And to the north, or south, restore the side.
Which, at its birth, did cold, or heat, abide.
So strong is custom; such effects can use
In tender frames of flexile plants produce.

There is a disease, which attacks the bark of fruit trees, called the *crab disease*, and which is supposed to proceed from changing the sides of trees, when transplanting them, to a point of the compass different from that toward which they before stood. This disease destroys particularly the inner bark, by reducing it to a blackish powder. The remedy is, cutting out the whole diseased part, and coating it with a plaster, made with equal parts of fresh clay, garden mould, and cow-dung.

Another fact, which deserves particular notice, is, that trees send out the longest and strongest root toward the south-west, in order to support themselves against the most frequent attack of the wind from that point. Hence, when a north-east storm happens, the number of trees blown down is triple that which falls under as great blasts from the opposite quarter.*

The ash, when in clumps, or in groves is much quicker in growth, as well as more valuable, than in open fields. Scarcely is there any tree so hurtful to all kinds of vegetables, according to Miller, as the ash, which robs every plant of its nourishment within the reach of its roots; therefore it should not be permitted to grow in hedge-rows, where it will injure the hedge, and impoverish corn, or whatever is sown near it. Nor should this tree be reared on pasture grounds, for if any of the cows eat of the leaves or shoots, all the butter that is made of their milk will be rank and of small value.

Amongst the trees which succeed on the generality of our high grounds, exposed to storm, the beech is found to be one of the most promising; it delights in a lofty situation, and in a gravelly soil, which is the better if it be calcareous. No tree is more easily raised, nor is any one more beautiful in forest scenery; it is also valuable as an underwood, and can be transplanted after many years. In bleaching countries, beech timber is extremely useful; and among the many purposes to which it can be advantageously applied, that of making felloes for cart wheels may be mentioned, for which it is employed in London, as it rends with more difficulty than even ash. In water-works it is unparralleled; for, when constantly kept wet, it is as perfectly sound at the expiration of 40 years as when immersed. The timber of this tree, as well as that of others, is with us superior to the same kinds in England. The laurel, which grows in Ireland to a considerable height and thickness, we have good authority for saying, does not grow with the same vigour in England; which may reasonably be ascribed to the greater severity of the winters in that country.*

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* Here being a strong indication of an instinctive faculty, we are thus furnished with another link for the chain of analogy existing between the principles of vegetable and animal life.

Many of the advantages derivable from planting larch and Scotch firs, arise from duly considering, that they will not only grow, but even thrive, in nutriment totally unfit for corn or grass. In corroboration of this, Mr. Pontey instances part of the extensive hills, which connect Yorkshire with those of Lancashire, Cheshire, and Derbyshire, having been planted from time to time, and that, wherever this has been properly done, the larch and Scotch fir have uniformly succeeded. So little nice are these trees, in regard to soil, that they are seen to thrive amazingly in beds of sand, washed from the higher parts of moors into cavities in their sides; nay in the hollows of old roads, or among the rubbish of stone quarries. They will likewise thrive, where several other sorts of trees will not; for instance, upon a common called Honley-Moor, Yorkshire, (part of the range of hills above mentioned,) Mr. Pontey occasionally introduced the oak, ash, beech, birch, and sycamore, not one of which succeeded; and he found that it was the same case with respect even to the common thorn.

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* The shade of the beech is very injurious to most sorts of plants, but is generally believed to be very salubrious to human bodies. Hence Virgil may have chosen his, '*recubans sub tegmine fagi*,' as being most truly expressive of the delights and salubrity of rural repose.

Mr. Hayes, as already observed, is an advocate for the Scotch fir, which he has found to produce, by proper culture, timber of as good a grain as the foreign of the same species of tree. "What an encou-"ragement," he emphatically pronounces, "is here "held out to the clothing of our nearly barren moun-"tains with this useful tree, when the slowness of its "growth, in the diameter of its stem, tends to its per-"fection; and where the necessary closeness in the "beginning would afford such thinnings as, in many "parts of Ireland, would produce a most profitable "and speedy return."

Mr. Pontey maintains, that, in most situations, the larch exceeds, in quickness of growth, every tree whose timber bears any comparison in value. It is equal to the best foreign deal timber, for all purposes to which it is usually applied, and greatly superior to it for many others; in as much as the boards are more free from knots, harder, and less apt to split, being nearly as tough as ash; and, having many of the qualities of that wood, will frequently be found a substitute for it. For the oak, also, in many instances, it will be found a good succedaneum; because it grows as well hearted as any oak whatever, and its interior is as durable. To which Mr. Pontey adds, that, in consequence of its beautiful colour and fine grain, being capable of receiving a very high polish, it will be found excellent for numerous useful and ornamental articles of furniture at present made of mahogany. In a word, it will supply the place, in a greater or less degree, of almost every sort of wood now in use, from mahogany to alder; and, if cultivated freely, will considerably diminish the consumption of the whole.

As the larch has not been known to fail in any ground, from the most fertile loam to the most rocky mountain, as of course it must be a hardy tree, well fitted to be a nurse to others, and as it is applicable to so many useful purposes, it unquestionably is a great acquisition to this country. It has this farther advantage, that, though its tops very early get an inclination from that point where storms mostly prevail, it is not thereby hurt in its growth, which will sometimes extend to the height of 50 or 60 feet. The first four years, it grows slowly; but, in the space of twenty years, it will exceed in girth and height any other of the fine tribe that is twice as old.*

In planting the elm, great care must be taken not to bury its roots too deep, especially if it be planted in a moist soil; in which case, if the clay be near the surface, it will be best to raise the ground into a height where each tree is to be set, by which the roots will be advanced above the surface of the ground, so that in winter they will not be in danger of rotting by the effects of moisture.

Treating of the culture of this tree, Miller takes occasion to shew the evils of bad management in practical planting; which he seems feelingly to regret, as operating so much against the necessary propagation of trees. Where plantations were made, a few years afterward, in the same places, in which the failures had occurred, with trees not a tenth part so large, they became more than double the size of the older ones, and continued in a most thriving state, whilst the others were little more than just alive. In these cases, it is not improbable, that the failures were ascribed to an unfavourable state of the air, and the successes to a propitious change in the climate; whereas, in fact, the former was owing to bad, and the latter to good management.

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* For planting on a large scale, in which case expedition is material, Mr. Pontey recommends two implements of his own invention, which he terms a *Mattock* and a *Planter*, for the structure and use of which, see his Book, page 34, 35, 36. And in p. 44, 45, are directions with respect to the size of the holes.

The sycamore deserves particular attention, especially in our great linen manufacturing districts, as it exceeds all other timber in the beam of the beetling engine, in a bleach-mill. It is a tree that agrees well with almost any soil, thrives near the sea, and frequently is found flourishing in demesne lands. It is curiously singular, however that this tree, which is one of our hardiest, does not thrive at Warringstown, county of Down, where the generality of trees grow better than in most other parts of that fertile and improving county.

There is a species of planting, called *reverse planting* which is performed by placing the trees upside down, whence the branches will become roots, and the roots will put forth leaves; in which way the lime tree *(tilia Europæa)* is a remarkable grower: but for the process, I must refer the reader to Miller's Dictionary. In this case, have we not an additional support to the analogy traced between the vegetable and animal economy, in as much as the lime tree thus may be made to send forth roots from its branches, and branches from its roots, in resemblance to the polype, from a middle section of which will proceed a head and a tail.

Attendance after planting, especially in windy weather and high situations, is essentially requisite. The plantation should be frequently gone over, and such plants as have lost their upright posture, or are loose at the roots, should be set straight and rammed; especially if the soil be of a light, open texture. In such a soil, indeed, it is prudent to ram them at the time of planting, which not only prevents their being misplaced by the winds, but also hinders the drought from reaching their roots as soon as when the mould is left light and porous. Keeping the plantations clean, also is, of the utmost consequence. A young plantation should be considered as a *kitchen garden*, and preserved from weeds with an equally sedulous care.*

SECT. V.

Pruning, Thinning, and Felling.

RELATIVE to that important branch of the planter's art, *pruning*, authors do not seem to be so contradictory, as they are in most other particulars of the business. It is universally admitted, that the heavy use of the knife, or saw, on the side branches of a tree, though prevented from being injurious, through the admission of frost or rain, still tends to weaken the stem, and to encrease the head so as to make the tree top-heavy, both which ought be guarded against, especially in our mountain plantations. Injudicious pruning will either cause the root to loosen, or will produce what is called *wind-shakes* in the future timber; whilst, on the other hand, the neglect of cutting off in time the ill placed luxuriant branches, permits improper boughs to take the lead, and fills the timber with unsightly knots. Besides, the want of timely thinning has the same effect on a plantation, which too severe pruning of the stem produces; in both cases, the trees are drawn up to weak and slender poles. No better general rule can be given than that of never suffering any part of a tree to interfere with its neighbour during a second season.

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* Miller. Marshall. Hayes, p. 23, 24, 25, 26, 30, 31, 58, 63. Pontey, p. 23, 28, 29. Irish Agricultural Magazine. Vol. 1. p. 280, 290, 291, 309. Tyrone Survey, Appendix, p. 41, 47, 48. Derry Survey, p. 430, 444. Down Survey, p. 154, 158, 163. Armagh Survey, p. 51, 53, 55. Gleanings in Agriculture. p. 103, 219, 332.

The leader is the principal and first object; the side branches may be afterward gradually taken off, so as not to wound the plant too much, nor let too much air at once into the plantation. In general a young tree should be encouraged in its lateral branches; and, at the time of planting, the great one only ought to be shortened, leaving on the small ones, which will detain the sap in the stem, and prevent the tree from being top-heavy. By this treatment, the tree becomes more capable of resisting the winds, which do greater mischief in Ireland than frost, drought, or any other exterior circumstance. To this method of pruning, the beech is stated as a particular exception, by Mr. Hayes and others; who affirm, that the less wood that is taken off this tree at the time of planting, the sooner it recovers the removal.

The usual space allowed timber-trees, standing amongst under-wood, is thirty feet; thirty-three feet, when the trees have fully formed their heads, will not be found too wide a space; and when, upon examination, any vacancies are discerned, they must be filled up from the parts where the plants are superfluous. When those that are intended for timber are too much crowded, they must be thinned, by cutting a proper number down to within a hand-breadth of the ground, leaving the young trees designed for *stands*, which must now be set out about 33 feet distance from each other. The young stands will require to be more or less pruned: their leaders, as in other cases, must be particularly attended to, the lower side-shoots taken off, and their heads reduced in such a manner as to prevent their being top-heavy; but, if the first fall of underwood be made in due time, their heads in general will want but little pruning. As soon, however, as the branches are firmly established, the heads should be pruned. In doing this, the leader must be shortened, to check the upward growth of the tree; and the main strength of the head ought to be thrown, as much as may be, into one principal arm, in order to obtain with greater certainty, the important end to which the timber of woods is more peculiarly applicable.

The young timber of the Scotch fir, Mr. Pontey observes, has generally been condemned as *brittle*, whilst the old has been rejected on account of its

knottiness,

knottiness, which renders it of little value for many purposes, and totally unfit for others; but had it been considered, whether the knots were natural to the tree, or merely incidental, it probably would have been discovered, that the defect had its origin in the want of proper management. In this respect, what is suitable for timber in general, is equally applicable to the Scotch fir, larch, oak, &c.

Knots are divided into *live* and *dead*; the former, which are such as are incorporated with the wood from the core of the bark, whether large or small, are the remains of branches that were alive either at or near the period when the trees were cut down; the latter are the remains of such branches as have been left upon the trunk after they have died, and sometimes until they have spontaneously fallen. In the last case, the trunk continues to grow in the interval, close upon the branches, but cannot unite with them, and therefore they become dead knots from that part.

Much of the evil attending dead knots may be traced to the woodman's method of pruning, by leaving knags or spurs, some inches in length. If the tree produce a shoot, near the end of the spur, there will be a live knot to that shoot, and a dead one beyond it; but when the tree produces no shoot, the whole length of the spur becomes a dead knot, so that, in either case, we have these defects, where otherwise the timber would be perfectly clean.

Aware of the bad consequences of large knots, the woodman will closely prune his trees, to a reasonable height, while the branches are small; not prune them all at once, but from time to time; by which he will, in a great measure, form the trees, though he cannot make one leaf of them. For dead knots and hollowness, he will apply the same easy preventive to all branches, great or small, as soon as they appear to be dead. And, by combining causes and effects, he will readily perceive, that, by this practice, most sorts of timber may be raised sound, and nearly clean to a sufficient length; as the knots will be very small, and found only near the core.*

As the value of elm timber consists more in the length and bulk of the shaft, than in the crooks and contents of its branches, it is the business of planters to train up the tree, tall and straight, to keep their shafts clean, and not to suffer them to branch till within a few feet of the top. The present mode of lopping, though conducive to the extension of the shaft, fills it with rough protuberances, which, by admitting water, are very

prejudicial

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* With firs it is universal not to produce shoots near the end of the spur; and the same is almost general with those trees that are in thick plantations. Trees, for shelter or ornament, should be pruned to suit particular situations. The beauty of the larch, when advanced in growth, is greatly improved by judiciously thinning the branches, which permits the lateral shoots to fall in a very elegant manner into the space formerly occupied by them, and adds greatly to the picturesque appearance of the tree.

prejudicial to the timber, and occasion the defects so generally complained of. It has also been observed, that the circles, which, when the tree is felled, shew its annual increase, are smaller the year after it has been lopped.*

In the management of natural woods, or of plantations, when they are believed fit for felling, considerable errors prevail. Few things have been more prejudicial to the landed interest of Ireland than the absurd opinion, adopted 50 or 60 years ago, on this subject, viz. that wherever a wood was felled, it was useless, if not detrimental, to leave a single reserve, and that no shoot from a tree once cut down, could ever grow to timber. This ill founded theory stripped extensive tracts at once, both of their ornament and shelter; whereas, a judicious thinning-fall, repeated from time to time, would have kept up the appearance of wood land in many districts of this country, and would likewise have produced, within a few years, an infinitely greater profit than the advocates of a general fall could ever hope for, at their highest calculation, even with compound interest to assist them.†

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* The ages of all trees, when felled, may be ascertained by the number of internal concentric circles or rosing rings in the substance of the trunk cut transversely; and the ages of the pine, cedar, apple-tree, pear-tree, &c. may be known while growing, by their annual boughs or branches.

† For judicious directions relative to the methods of thinning plantations, and the advantages thence resulting, see Dutton's Irish Agricultural Magazine. Vol. I. p. 278, 280.

It is very injudicious to fell oaks in the spring, when the sap is flowing. This is done for the sake of the bark, which will then easily peel off; but by so doing, the timber is not half so durable as that which is cut down in the winter. It will be most advisable to disbark the trees while standing, at the proper season, and leave them to the next, or to the second winter, before they are cut down; by which management, the timber of these trees will be found more durable and useful, than that of any others which have not been peeled.*

The best season for felling ash trees is from November to February; for if it be done either too early in autumn or too late in spring, the timber will be subject to be infested with insects; but for lopping pollards, the spring is preferable for all soft woods. The ash bears lopping very well.

As the trunk of the ash and of several other kinds of trees are not disbarked when cut down, it is not amiss to observe, that the species of beetle, (*cerambix violaceus*) which brings on the decay of wood, never attacks timber that has been stripped of its bark; a circumstance which shews the advantage that would follow decorticating all trees, and which ought to be attended to by all persons who have concern with this article.

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* It is reckoned that oak, in a good soil and situation, at 75 years from the acorn, may acquire 40 feet length of shaft, and being 14 inches girth at the base, 12 in the middle, and 10 at top, it will be one ton of timber; and that, in 75 years more, it would produce above seven times the quantity.

The larch has this advantage, that it may be cut down at any season; but the best season, according to Mr. Pontey, is in August or September, the principal time of its growth. This is contrary to the prevailing opinion and practice, in regard to other woods; but when the properties of sap in general are considered, in opposition to that of firs, this time for cutting will appear natural. The sap of most deciduous trees, or such as cast their leaves, is only a thin watery fluid; and, if the trees be cut down when that is in circulation, it tends to rot them; while the sap of the larch, being the purest turpentine, hardens in the pores of the wood, and resists moisture; hence the durability before mentioned. Another quality peculiar to this tree is, that, though cut down as observed, it will not crack with a moderate degree of heat.

Some general observations on underwoods or coppices may be useful. The heads of the stools should be but little, if any, above the surface of the ground; the underwood should be smoothly cut as close to the stool as possible, before the sap is in motion; and the fallen stuff should be cleared away prior to the issue of the young shoots. To the stumps of oak trees, immediately after being cut down, Mr. M‘Evoy has applied lime with remarkable success.

As to decay in trees, there are some external circumstances by which it is pointed out. The wood-pecker not having power to penetrate a sound tree, the perforation of any tree by this creature is a warning to the owner to cut it down. And, it is an infallible sign of hollowness, when there is a swelling vein, which evidently discovers itself above the rest of the trunk, though invested with bark, and which frequently encircles the tree like ivy. The elm is often attacked by a disease that makes the bark bleed and burst; after which the tree decays and becomes hollow.*

SECT. VI.

Fossil Timber.

AMONGST our fossil timber, oak and fir abound most; yew is also frequently found, especially in some of the northern counties, for instance, in the county of Down. Hence the town of Newry, in that county, is said to derive its name, *na-dhur*, pronounced *najur*, signifying, 'of the yew-tree.' But the etymology of the name may be better explained thus: the fresh leaves of yew are poisonous to the human species. Black cattle are sometimes killed by browsing on the branches that are cut off and half withered. Sheep and goats eat it; but the former are said to have been killed by nibbling at the bark. Cambrensis ascribes the scarcity of bees, in his time, partly to the quantity of yew trees then growing here. Now, *idho*, pronounced *iyo*, the yew tree, *narr* a serpent, poisonous, will form *Narriyo*, or Newry, the place of the poisonous yew tree. And, as an additional proof that the yew tree was, in early ages, a growth of this country, the reader's recollection may be here recalled to an observation made in the Preliminary Considerations, namely, that the yew tree was included in the 1st class, or *Airigh* timber, against the destruction of which provision was made in the Brehon laws.

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* Miller. Marshall. Hayes, p. 20, 60, 71, 6. Pontey, p. 12, 19, 26,—7. Irish Agricultural Magazine. Vol. I. p. 277. Tyrone Survey, Appendix, p. 55,—6. Kilkenny Survey, p. 566, 9. Gleanings in Agriculture, p. 128, 204, 266, 383.

What species of fir is the most prevalent in those situations, does not seem to be yet well ascertained. My friend, the Rev. G. V. Sampson, whose taste for scientific and literary research is strongly seconded by ingenuity, asks: Is the Scotch fir a fosil wood of our bogs and wastes? That it was indigenous in some parts of this country, in very remote times, is beyond a doubt, because cones of it have latterly been found buried deep in our bogs, and from those seeds genuine trees of this species have been raised. From the Irish language also, we have collateral evidence that the pine tribe was not a stranger here in days of yore. *Bras*, a lance, anciently written *barus* or *burus*; whence so many places of that name, in Ireland, meaning a plantation of pine-trees. Of these, spears or lances were formerly made; hence *bras-comhrach* a tilt tournament, that is, an engagement with *bras* spears or pikes, for show or pastime. These spectacles were ordained by *Luighhaidh*, long-handed, one of the leaders of the *Tuatha-Dadann* colony into this country, in honour of *Tailte* daughter of *Maghmor*, king of Spain. *Bras* is the root of the Irish war-cry, *breisim-breisim*, that is, to arms, to arms, lances, lances, &c. It is moreover found in *brosda*, *prosda*, a tall, strong man, like a pine or fir tree.*

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* Valancey's Vindication, p. 154, 532, 535. Prospectus, p. 18, 58. Withering's Botanical Arrangement, Class XXII. Order XIII. 390. Down Survey, p. 152. Derry Survey, p. 440. Id. Appendix, No. 4. p. 39.

CHAP.

CHAPTER V.

On the Structure, Utility, Cultivation, and Disease Of the Flax Plant.

THE common Flax plant, *Linum Usitatissimum*, is the 5th Class, Pentandria, five stamens, 5th. Order, Pentagynia, five pistils, Spec. Plant. 277 of Linnæus. It is an annual plant, which rises with a slender unbranched stalk, garnished with narrow spear-shaped leaves placed alternate, ending in acute points, and of a high green colour. The flowers or blossoms, which are pale blue, are produced on the top of the stalks, each stalk sustaining four flowers, composed of five petals or leaves, which are narrow at their base, but broad at the top, where they are slightly crenated or scolloped. The empalement or cup of the flower is cut into five parts, which end in sharp points. The flowers appear in June or July, and are succeeded by roundish capsules or seed-vessels, provincially called *bows* or *bowels*, which have ten cells, opening with five valves, that are terminated in narrow ends; each cell contains one smooth flattish seed, ending in apex, and of a reddish brown colour. The seeds ripen in August or September, and soon afterward the plants perish.

The stem of ripe flax, newly pulled, is found to be composed of four distinct substances, viz. a thin cortex or rind, a green sap, the fibrous or filamentous part, and the ligneous body. The sap or succulent part is again composed of an extractive matter and water. The fibrous part is also provincially termed the *bark*, *reed*, or *harl*, and is the part of the plant which is employed in the manufacture of linen; the interior ligneous substance is likewise called the *wood*, *boon*, or *show*, and is that portion which is separated in the preparation of the stem for the use of the manufacturer.

Amongst the various uses to which the flax plant, or some of its parts, is applicable, the manufacture of linen cloth is one of the most important, and is that only which here claims our attention. This plant requires a good soil; and the success with which it is cultivated in every part of Ireland, shows how well the soil, whose prevailing characteristic is luxuriant fertility, is calculated for its production. The success, also, with which it is applied in our linen manufacture, whereof it is the *primum*, testifies how well adapted this country is to the manufacture; a manufacture at once qualified to invigorate the spirit of industry, to augment the streams of commerce, and to bring riches and comfort to the land. These effects it must naturally have, in as much as it is a manufacture which not only sets in motion the productive labour of the workmen immediately employed, but also that of the persons who are engaged in raising or preparing the primum, on which it operates. " In whatever point " of view we consider *Ireland*," says Mr. Preston, " it " will appear, that nature, her habits of industry, " her particular circumstances, her political relations, " all concur in pointing out the linen manufacture, " as the prime object of her exertions."*

The *primum*, therefore, of a manufacture, so important to the nation, demands the most serious and unwearied attention, to put it on a productive and secure footing. The first point deserving particular consideration is the domestic culture of flax-seed. The annual import, of this article into Ireland, is estimated at forty-five thousand hogsheads; thirty-five thousand from America, and ten thousand from Holland, Riga, and Memel. Taking the average price at 5£ per hogshead, which is the lowest admissible calculation, the importation of flax-seed will cost the nation the yearly sum of 225,000£ sterling. But, were the calculation to be made from an experienced maximum and minimum, the cost would be above 100,000£ more. For, in the season, 1803, flax-seed flax-seed sold, in Derry, at the enormous price of 12 guineas a hogshead, and, rating the minimum at 3 guineas, the medium of the ten terms would be seven, which would produce a sum of 315,000 guineas.* If to this we add the annual loss by the carriage of money, as well as of people, from Ireland to America, in those vessels that bring over the flax-seed, which is chiefly done in American bottoms, the balance of trade, together with marine education, will be found greatly against us in this branch, and therefore calls loudly and imperiously for the intervention of the state. It is true, a late statute apparently restrains the passenger trade; but the restrictions will be evaded, and the balance, in cash at least, will continue against us, because a wealthy description of yeomanry still will emigrate, until a more effectual bar be put in the way. To the progress of this national disadvantage, perhaps no more powerful obstacle could be opposed than to cultivate at home our sowing flax-seed.

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* Trans. R. I. A. Vol. IX. *Science*, p. 184, 224. Mr. Preston considers Ireland not only qualified but inclined to become, in the [illegible] of linen, the *Egypt of modern commerce*; and shews the just [illegible] this country has to a proud pre-eminence in the manufacture. [illegible] Work, p. 238, 253. Ireland, moreover, is capable of [illegible] the Egypt of our Empire with respect to the pro-

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* The maximum price falls upon the poor, as it generally takes place at the close of the season, (which was the case the above season in Derry,) when only the most indigent have to purchase, and is on them a prodigious hardship, since it amounted then to nearly 4 shillings a gallon, whilst the wealthier cultivator purchased it at 1s. 7½d. per gallon, when at the same time, the *hired* ground of the former description was probably at the rate of 4 guineas an acre, and the rented land of the latter about one guinea. Hence also, seeing that the seed varies so much in price, while we import flax-seed, the linen trade must be liable to uncertainty, perhaps more than the trade in any other commodity.

The advantage of saving our sowing flax-seed is questioned; and it is argued, that it would be more our interest to import seed, and to give our produce and manufactures in exchange for it. But what articles do we give to America? We give the population, the skill, and the cash of our country. These are articles which no barter on their side can compensate. It is true, there is an exportation of plain and coloured linens, and some minor things, but the quantity of all is too trivial to be compared to the above mentioned exhausting drains. The provisions shipped here are merely for the supply of the passengers on the voyage, and are not to be included in the account. And it is probable, from the advancing state of American manufactures, that the exportation of our fabrics to that continent will grow annually less. Besides, as every perceptible circumstance should be taken into calculation, it is reasonable to ask, in case of a misunderstanding with America, at any future period, and that our supply of flax-seed from it would in consequence be stopt, or be materially impeded, what mischiefs would ensue to our staple manufacture, if depending so largely on that country for the rudiments of the primum. What desirable and lasting benefit, then, do we reap by our flax-seed trade with America? And with respect to Holland, I believe our return of produce to that country is in fact *nothing;* to the Baltic likewise nothing, or next to nothing.

Hence, with Mr. Preston, I concur in thinking, "that it should be the care of the legislature to "put this precious manufacture, on which the very "existence of this country depends, out of the reach, "if possible, of time and chance. To forward this "great and desirable object, the farmer should be "induced, by premiums, to cultivate flax, not merely "as the *primum* of a fabric, but for the purpose of "saving the seed. This appears to be a very profitable "species of husbandry; and were it generally pursued, might relieve us from the apprehensions of "scarcity. I know it is supposed by many, that "flax-seed produced in this country is inferior in quality to that which is imported. I am apt to think "this a mere prejudice; at least it is an enquiry "well deserving the attention of this country to "ascertain the truth, and determine, by a course "of experiments, whether flax-seed, saved in this "country, does not afford as abundant crops, and "flax of as good a quality, as seed which is imported from abroad. If there were any overplus "of seed beyond the demand of the flax grower, "it might turn to good account at oil mills".

The Dublin Society once thought, that to rear our own flax-seed would be a public benefit, and gave premiums many years ago for saving and hoveling it.* Some of the seed saved is yet in certain parts of Ireland, and is considered better than any imported. One of the reasons given for this superiority is, that the home produce is not adulterated, which frequently is the case with imported seed, it being mixed either in the foreign country, or in this, with stale seed, before it is exposed to sale. Besides, a species of seed, which produces branchy flax, that is not fit for manufacture, being only for crushing, may be mixed with the foreign, as the plant which bears it is vastly more birthy than the species proper for manufacture; and this is a fault which an inspector of flax-seed cannot possibly detect, nor can it be guarded against by our legislature in the case of foreign seed. But a remedy might be provided against the exposure of such seed to sale, if it were the produce of our own country, through the influence of attestations and penalties enacted by law.

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* The Commissioners and Trustees for Manufactures in Scotland continue to give premiums for flax-seed saved, and certified by the Surveyor to be fit for sowing; one shilling per peck, to the extent of 20 pecks for each acre.

During some years past, farmers, in the County of Derry, have been in the habit of rearing seed for their own use and for sale. Experience has proved, that seed raised from the Dutch, upon good clay ground, is equal, in every respect, to the best imported; nor is it found necessary to recruit this home raised seed, by having recourse to the Dutch, every second year, as was till lately practised. The same attention, which is paid to changing the soil of other seeds, is sufficient for flax-seed.* "I have examined," says Mr. Sampson, "seed in hand, and have seen the crop from it "now growing, which has been five years *run*, "that is, sown without change of foreign seed; and "I think, it merits a higher price than any other "which I saw this year, 1802. The truth is, that "the country retailers did purchase a good deal "of the home-raised seed, which they mixed with "the old Dutch, and sold for new; and lucky it "was for the country, to which it was sold, as the "cargoes, which had been many years condemned "in Scotland, found their way through the port "of Derry into our county, to the great detriment of the persons who sowed." But, although the season was remarkably favourable for flax, the old Dutch seed, by itself, above mentioned scarcely promised a half-crop.

If designed for seed saving, the plant must not be pulled till the blue blosom falls off, and the head is full, or, as it is in some places termed, until it is black in the bows. As to the advantages said to arise from pulling it green, a chief one is, that it splits with less labour; but with respect

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* We no where hear of flax-seed being depraved in ancient Italy, by cultivating it at home for seed. The old Romans sowed flax seed, in a rich soil, and covered it well with the earth, from the 24th of September to the 4th of January.

"Necnon et lini segetem et cereale papaver
"Tempus humo tegere, et jamdudum incumbere aratris."

Virgil, Georg. Lib. I. v. 212.

Linseed and fruitful poppy bury warm
In a dry season, and secure from storm.

to its making in this state finer yarn, this is probably a mistake; for, in the low countries, as they are named, the finest flax is raised, and, where it is manufactured into the nicest laces, it is never pulled till the seed be ripe. In this country, the seed-flax, well managed, will spin to the fineness of eleven hundred, which is a grist of extensive utility. If it be not spun or used at home, the farmers need not apprehend that it will lie upon hand, as there is a great annual demand for rough flax, of every staple, in the rope and sail making business, both in England and Scotland, whence orders and buyers come every season to Ireland.*

In good weather, flax-seed is very easily saved, but with difficulty in a rainy season, and cannot be well accomplished without cloths. In doing it the branches are spread on the ground till they grow yellow by exposure to the atmosphere; in this state they are preserved until next season, when they are threshed, winnowed and cleaned. This method is preferable to shelling the seed from the head, by running it through a common corn-mill. When premiums were offered for saving flax-seed, it was forbidden to stack it before threshing, which now appears to have been an erroneous injunction; for excellent seed is saved in the preceding manner. The only difference is, that, in the treatment here recommended, the flax must be left to stand a little longer than usual after flowering, that is, till the head grow quite yellow, as already directed. To dry the flax, after pulling, Miller recommends a method, in this country called *goating*, which is, setting the flax upright in small sheaves or handfuls, till it be perfectly dry, and then to house it.*

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* Flax from plants that have *seeded*, is in some parts, distinguished by the name, *seed-line.*

Of this valuable plant there is not a part, but can be applied to some useful purpose. The very refuse of flax, or the most gross tow, called *hurds* or *backings*, produces a material that may be manufactured into a coarse but comfortable cloathing, of the fustian kind, with which any person who has a loom may cloath his family for a mere trifle more than his own industry. This, Lady Moira calls *factitious cotton*, for which she employed *fired* flax, on account of its being ill flaked, and therefore thought improper for linen cloth.† But unless

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* The same writer, (Dictionary Art. *Linum*,) by repeated trials, found sowing flax seed in drills preferable to broad cast; the drill at about ten inches distance from each other. This will allow the flax to be more effectually cleared from weeds, will enable the stem to grow firmer, and will invigorate the seed. If this method would not be eligible in raising flax for the finer fabricks, it might for *seed-saving*, and the coarser stuffs. Although the reed of flax may be coarse and hard, yet as such sort, when exempt from *firing*, splits well, it may be reduced to a fine *grist* by the hackle, and will probably be made to draw to a finer thread than eleven hundred. The advantage of flax splitting well was experienced in the crop of 1803, which was in general very short, but, having a firm, sound reed, it spun remarkably well, and lost comparatively little in the dressing.

† Another sort of cotton, viz. *animal cotton*, has lately been discovered. M. B. des Lozieres (American Phil. Trans. Vol. v.) gives an

it be uncommonly cankered with that disease, it can be wrought up in the manufacture of some description of linen. Nevertheless, when deeply *fired*, a degree of the *spirit* must always remain discernible, for were it to be obliterated in the bleach, the texture of the cloth would be extremely weakened, or nearly destroyed.

To disengage the flaxy part, or the *lint*, from the different substances with which it is combined, when the plant is ripe, it is submitted to a steep in water, then spread thin on the ground, and exposed some time to the bleaching effect of the air. When in a fit state to be lifted, the flax is of a greyish white colour, very flexible and tenaceous, and wholly free from the extractive matter and sap. Nothing now remains but the reed and wood; to separate which, the flax is kiln-dried, or dried in the sun, *bettled*, *scutched*, and *cloved;* afterward it is *hackled*, or *dressed*, by which it is split into the proper fibres or filaments for spinning,

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an account of this substance, which is produced in St. Domingo, by the Ichneumon fly on the body of the Cassada-worm, where it insinuates its eggs. From these eggs are hatched animalcules, who work small Cocoons in which they wrap themselves, and which form the cotton. This cotton is of a dazzling whiteness, is beautifully fine, is not attended with any of the difficulties that occur in the preparation of vegetable cotton, and, having not the smallest refuse, is so pure that as soon as the Ichneumons leave it, which happens in eight or ten days after their reclusion, it may be carded and spun. Besides, in obtaining this cotton, there is no need of any of the precautions which the silk-worm requires. The robe which covers the Cassada-worm, or fly-carrier, is worked every where, and every where perfectly well.

ning, and the short lint or various denominations of *tow* are obtained.

Before the yarn is put into the loom, it is partly purged of its colouring matter, by scalds in alkaline leys, and subsequent exposure to the atmosphere. When the linen comes from the loom, it is impregnated with a farinaceous paste, called weavers-dressing; to discharge which, it must be steeped in water, and afterward well washed. The cloth now contains nothing that water can separate, and is of a greyish colour, although the fibres of which it is composed, when divested of every adventitious substance, are naturally very white.

The matter, which thus colours linen cloth, is of a *resinous* nature,* insoluble in water, and, from its intimate union with the fibres of the flax, its separation is difficult, even by those substances which have a solvent power over it. To disengage it, however, in as expeditious a manner as possible, without injuring the texture of the fabric, is the sole object of the process of bleaching. The principal menstrua for this purpose, are, vegetable and mineral alkali, sulphuric acid, sulphuret of potash or of soda, sulphuret of lime, oxymuriat of potash, oxymuriat of lime, soap, and atmospheric air.*

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* Almost thirty years ago, the patriotic Lady Moira, distinguished for a spirit of research, observed, that the fibres of flax require to be separated, which is done by the dissolution of some *resinous* substance, whilst the oil of the plant is converted into a kind of soap; an intimation that in the flax plant is contained a *resin*, which must undergo a change before the manufacture can be pursued. Antholœgia Hibernica, Vol. III. page, 38.

Mr. Kirwan, in 1789, by treating the colouring matter of linen yarn with alkalies, found that the resinous substance, which composes that matter, differs from pure resins only by its insolubility in essential oils, in this respect resembling lacs. Perhaps, then, it is a species of gum-resin, which consists in a mixture of resin and mucilage. Dr. Curry who published in 1779, believes the colouring matter to be of an oily nature, not soluble in water, but soluble in strong spirit of wine or alcohol; an opinion which favours the idea of its being a gum-resin. This colouring matter is known to the workmen by the name of sea-green.

In linen cloth, after having been spread on the field, or immersed in oxymuriatic acid, may be observed a *buff* hue, which, by the test of alkaline prussiat, Mr. Grimshaw has shewn to be occasioned by the presence of iron. The oxygenated acid produces an iron-mould, that is, the colour becomes *buff* or *golden*; but use the sulphuric acid, or the marine, and the colour shall be discharged. Not only in the raw material, but in consequence of the weavers preparing their *dressing* in iron pots, is the cloth impregnated with this chalybeate oxyd. Cotton cloth is liable to the same kind of stain, from the same causes. Men, versed in the theory and practice of bleaching, know that the same process is applicable to linen and cotton; that the former requires only a stronger process, or more time, than the latter; that iron oxydated and iron-moulds are the same; and that the quality of cloth is thereby injured, these stains being generated by combustion, in consequence of the union of oxygen gas.*

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* Higgins on Bleaching, Sect. I. Id. Sect. II. p. 27, 28, 32, 33. Sect. III. p. 34, 35, 50, 51. Sect. IV. V. p. 53, 70. That able chemist, in this Treatise, has furnished a happy instance of the application of science to the useful arts; which evinces how earnest we should be in our endeavours to draw from his retreat, by every motive of reward and honour, the man of a philosophical bent, and induce him to devote his talents to the practical interests of society. 'Manufactures may be expected to attain the most perfect maturity, when reason and philosophy, 'stooping to the purposes of common life, take the manufacturer 'by the hand, and lead him through the temple of science. Then, 'method is added to research, and principle to experiment. One 'discovery becomes the parent of another; and scientific truths and 'commercial advantages proceed with equable march, and sisterly 'affection.' Preston, Transact. R. I. A. Vol. IX. Science, page 280, 88.

When the cloth becomes pretty white, small dark coloured specks, which the bleachers name *sprat* or *sprit*, appear in it, and are more numerous in some webs than in others, these specks, which are received by the flax while growing, are of a morbid nature, and constitute the disease in flax called *firing*, or *firing on the foot*, because it takes place whilst the plant is yet standing. By the majority of farmers, it is supposed, that it is caused by electricity, and by many of them, that it happens most frequently in wet ground and wet weather. This Dr. Curry endeavours to explain by alleging, that the electric matter operates by means of the exhaled vapour, which affords a conductor for it to the plant; but this explanation, we shall presently find, is not warranted by the circumstances of the case.

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* Mr. Higgins has shewn, that on the bleach-green a slow combustion takes place in the cloth; the oxygen of the atmosphere unites with caloric and forms oxygen gas; and this gas, in concert with alkali, discharges the colouring matter. See also Gren's Chemistry, Vol I. Chap. VI.

Like other vegetables, the flax-plant is liable to be injured by causes which operate on it, from its seminal state, throughout the several stages of its progress to maturity. But as the above disease is the chief, and the only one which claims consideration in this place, our enquiries are to be confined to the investigation of the causes of it alone. The *specks*, *spots*, or *ticks*, in which the disease consists, are of a brown or a reddish colour, and are dispersed throughout the stalk, or over some of the leaves of the plant, producing corroded or cankered marks in the substance of those parts. These specks generally appear first on the stalk, often near the root, thence spreading upward; but sometimes their earliest eruption is on the upper leaves next the blossoms, and then their colour is in general reddish.

The disease is said to take place oftenest when the flax is thick sown and advancing toward ripeness; and it is generally believed, as already stated, that it occurs for the most part in rainy seasons. But from observation it appears, that this latter opinion is not well founded, at least that it is not without exception; for instance, in a comparison between the flax in the year 1801, and that in 1802. In the former year, the flax suffered considerably by the disease; whilst, in the latter year, it was a full crop, and of a good quality, little or no firing having happened; yet upon the whole, as to rain, 1802 was to 1801 in the ratio of more than 36 to 32, and during the months, when the flax might be injured by wet weather, the proportion was above 13 to 9. To rain alone, therefore, we have not reason to ascribe the disease; on the contrary, it has been observed to occur often in dry summers and rich soils, whilst in humid seasons and poor soils, the plant has escaped it. As to the influence of wet ground, I knew a piece of this description in which flax, in the year 1801, suffered little or nothing, whilst the flax, in in the driest and best lands about it, was very much fired.

In order to show by facts how much the quality of flax is vitiated by this disease, and thence to enforce the necessity of attempting to trace its nature, I shall draw a comparison between the produce of this article in the above two years, 1801 and 1802. A *beet* or sheaf of beetled flax weighs 20lbs, what is termed good weight by the farmers. In 1801, the quantity of scutched flax, procured from a beet, was from 2½lb. to 5lb. rarely so much as the latter; whereas, the quantity gained, in 1802, was from 5lb. to 7lb. In the former year, an acre of land produced only about 8 stooks of beetled flax, 12 beets to the stook; in the latter year, the same measure of land yielded from 13 to 16 stooks.

This great comparative difference makes it a very desirable thing to discover a remedy for the evil, the best avenue to which is through a knowledge of its causes. Of the vegetable diseases, mentioned in Prelim. Consid. page, 43, 44, the only one that seems to bear any analogy to *firing* in flax is the *uredo frumenti*, or blight in wheat, which probably is a gangrene in the plant. But the cause and cure of this defect do not seem to be yet traced in any satisfactory degree. The *smut* in wheat is a seminal disease or decay of the seed, supposed to be in consequence of its want of impregnation with the male farina. If this were the cause of the malady, means of prevention would be used in vain; whereas it is found, that certain measures have been employed with success for that purpose, as well as for preventing the depredations of the worm. The measures for prevention are, steeps composed with chamberley and quicklime; with chamberley and common salt; and with water and arsenick. To cure the *rust*, the wheat is suffered to stand unreaped three weeks or more after the usual time; again that term, the sun and air will destroy the insects supposed to occasion the disease; and the knots will then open, whilst the sap passing up will recover the grain. The smut is removed by sinking a vessel containing the seed beneath a running stream of water, or under a pump, stirring it briskly with a broom, by which the noxious balls, if any, will float away, or may be skimmed off; and, if there be not any balls, but some of the powder only adhering to the seed, this kind of brushing agitation will cleanse it from every particle of the pernicious matter, and then will the seed be in proper condition for sowing.

Whether any of these expedients would be applicable to the preservation of the flax plant against *firing*, I am not qualified to determine; but, as the nature of the respective seeds appears to be different, and as the phenomena attending their diseases are of a different description, there is no reason to adopt the affirmative, viz. that either the preservatives or the remedies would be equally useful to the flax-plant as to the wheat. If any similitude exist between the *rust* in wheat and the *firing* in flax, the cure of the former would not answer in the case of the latter; for as soon as the firing is perceived, the flax must be pulled ed without any avoidable delay, otherwise the evil will proceed to a very pernicious extent.

That vegetable parasite, called Dodder or Hell-weed, *(cuscuta europæa)* is a very singular plant. As soon as it creeps up another plant, it quits its root, and is fed by the plant on which it fastens, and thus will its branches run from one another a furlong or more. Among the plants which it infects, flax is numbered; but I am not acquainted with any observations which shew that it invades the flax in this country, and, I think, there is no reason to suppose, that it has any share in causing the disease under consideration.*

As lightning, or atmospherical electricity, is reckoned a principal cause of the disease, it is necessary to take a further view of the effects of this meteor on trees and plants. It was the opinion of all the ancient Roman philosophers that the olive, the fig-tree, and the laurel are never struck by lightning. Toaldo, a modern meteorologist, observes that it is only those trees, which contain resin, that can perhaps escape the danger of this meteor; such as the above trees, and some others of the like kind. M. De Lamanon thinks it possible, and even probable that trees of this description may be less frequently struck by lightning than those which contain a great deal of aqueous juices; but he asserts, that they are not as good conductors as those in common use; for both fig and olive trees were burnt and torn up by lightning during the great electric fog, in 1783, and, as he learned, had also been the case in former times.

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* Some farmers impute firing to a certain inexplicable influence of the leaves on the stalk of the plant, exerted by means of the mechanical act of clinging; but, as they cannot give any explanation of this process, it must lie over for future inquiry.

The same author, in traversing Provence, Dauphiny, and Piedmont, to trace the cause of the fog, observed a great many trees stripped of their bark by the lightning, and he remarked that the part of the bark, or of the wood, carried away, was almost always broad at the bottom of the tree, and narrow at the summit; whence he infers that the lightning met with obstacles, and that it had not the same force when it attacked the higher parts of the tree. He thinks that the lightning, which produced these effects, was all ascending; and he often perceived holes at the roots of the trees which had been deprived of their bark. He observed likewise, that dry land had been less struck with the lightning than moist land, which induced him to believe, that the far greater part of the electric phenomena that year was ascending.

If resinous vegetables be conductors of electron, the green flax plant, whose colouring matter, we have shewn, is of a resinous nature, may be included in the number, and consequently prepared to escape damage by lightning, whether of the ascending or descending species. The above phenomena attending plants injured by lightning, as well as the majority of those stated in Prelim. Consid. p. 42, bear not any similitude to the appearances exhibited in flax firing. With regard to the agency of silent atmospherical electricity, which plays among the clouds and throughout the air, it is always harmless, and cannot by any striking force injure plants, as mentioned, page 43. The lightning of this description, which took place about Derry, in August 1801, the year in which flax suffered so much, did not happen until the flax was nearly all pulled, therefore it could not be accused with being the cause of that mischief. If we might reason from the operation of that lightning on barley and oats, which it suddenly whitened in a remarkable manner, we should conclude that it would not occasion firing in flax, the phenomena in the two cases being quite different.

On the supposition, that lightning or atmospheric electricity has any share in producing the disease, it would probably act by its stimulus exhausting the irritability of the plant, and thus laying the foundation for gangrene or canker, a species of which the *spots* in flax firing seem to be. Or by the decomposition of water in the vessels of the plant, by means of atmospherical electricity, a redundancy of oxygen might be set loose, which would hyperoxygenate the juices, producing a species of combustion or firing in spots, as appears in this disease. Would terrestrial electron, in passing to the atmosphere, operate on the plant in either of these ways? However the action of electricity, be it great or small, does not seem to be direct and by means of its mechanical or *striking* faculty, but indirect and physical, by virtue of changes gradually wrought on the juices and fibres of the plant.

The flax, produced from Dutch and Riga-seed, particularly the former, is accounted less susceptible of the disease than that from American.* In what sort of ground the Riga-seed is raised, I am not informed; but, as already observed, the Dutch seed grows in deep, strong clayey loam, which of course is the species of ground on which it will succeed best in Ireland. In several of our districts, chiefly in the southern and eastern counties, this description of soil abounds. In those places, therefore, the Dutch seed should be cultivated, especially to get stock for *saving*; a system which, as already shewn, should be commenced without loss of time, and pursued with energy to its full extent.

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* It has been supposed that the Philadelphia seed, and that from the more southern states, are apt to yield a crop more liable to the failing than flax from New York seed. But this idea proceeds from wrong information; for a great deal of what is sold under the denomination of New York seed is sent from Baltimore, and from some of the other States, to New York for exportation thence, on account of the repute which seed from the latter place had obtained in Ireland.

For, besides the national gain on the score of trade, there is the strongest reason to believe, on the principles of analogy, that by the naturalization of the seed to our soil and climate, the plant would in future be seldom and little invaded by the disease.*

It appears to come naturally within the province of our flax-seed inspectors to investigate this matter. For which purpose, after the seed shall be sown, when the season of inspection would be over, they ought annually to visit several farms, fifteen or twenty miles round their respective ports, and ascertain the nature of the soil by suitable experiments and observations. At the same time, they ought to note the denomination of flax-seed, the acreable quantity sown, and the date of committing it to the ground. During the progress of the plant, they should make a sufficient number of visits, to inspect the various circumstances of its growth, and, in particular, to watch the signs and symptoms of the *firing* disease. They also should take measures to promote and regulate seed saving, by circulating amongst the farmers a knowledge of such expedients as are found to be most favourable to the process. Along with these objects of inquiry, they should pay attention to the states of the weather, of which they ought to keep a diary, marking in it the several atmospheric phenomena of rain, drought, electricity, &c. endeavouring to trace in each observation the share which any one of these phenomena has, upon the constitution of the flax-plant.

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* Monaghan Survey, Chap. XII. page 185. Derry Survey, page 348, 349, 350. Trans. Dublin Society, Vol. I. Part II. page 1, 22. Curry's Elements of Bleaching, page 57, 118, 142, Edit. 1779. Philosoph. Magaz. No. 17. page 83, 6.

M. Gouteron (Mem. de l'Acad. Roy. des Sciences l'an. 1709) thinks, that the canker in plants has an analogous cause to that in animals, only that, in the latter, internal corrosive humours occasion the disease, and, in the former, the aerial nitre, particularly when condensed by severe frost as the frost of the year 1708. Thus have we hinted, nearly a century ago, the effects of hyperoxygenation combined with the mechanical expansive operation of frost on vegetable juices.

It would likewise be adviseable for the inspectors to take steps to discover whether a soil make any difference in the specific gravity of flax; as it has been asserted, that a pound of flax, the produce of a rich soil, spun to the same length of a pound from a poor soil, shall be finest and yet be equal in weight. This seems a point of importance to determine; since the mathematical sleaing tables are calculated by the weight of the stuff. However, by some it is thought, that the quality of the soil makes little or no change in the specific gravity of vegetables, in different kinds not exceeding a 50th part; and considering the many purging operations flax and its yarn undergo before the thread is brought to the loom, that trifling difference, if not entirely removed, will be very much lessened; for the difference arises from the juices imbibed by the plant, which it retains only when fresh, and which do not continue in the drained and dried fibre, whilst the solids, as already observed, constitute a small portion of herbaceous vegetables.

In correspondence with this view, there should be provided for each inspector a portion of land, from a rood to an acre, which ought to be divided into a given number of plats, each plat to be converted into a certain denomination of soil, resembling severally the soils in which flax-seed is usually sown, or should be sown. Here experiments are to be made with different kinds of flax-seed, and the results compared with the observations made on the farmer's land, so as to obtain practical conclusions. On each piece of ground should be built a lodge, to preserve the various articles for the experiments, and to keep meteorological instruments, namely, a barometer, thermometer, and hygrometer. On the top of the lodge should be erected a weather-cock; and in a convenient spot of the ground should be placed a rain-gauge; which latter instrument, with the hygrometer, would be particularly advantageous, as vegetation is so much connected with the quantity of rain that falls, and the degree of moisture in the air. It is obvious, that these provisions ought to be made at the expense of the Linen Board.

To this Board, no doubt, the inspectors would be enjoined annually to return copies of their proceedings, and the trustees would consequently arrange and digest the materials, so as to obtain from them deductions calculated to advance this desirable branch of rural economy. In the course of this system of inquiry, the inspectors would have the best opportunities for improving their knowledge in the duties of their office, to the increased credit of themselves, and the benefit of the public. Not only from the new line of duties here suggested, but from those belonging to his appointment; in the first instance, it is manifest, that an inspector of flax-seed ought to be an intelligent and a well informed man, and unquestionably no other should be intrusted. At the same time, let not the persons now holding these employments apprehend, that, by performing the additional duties here recommended, they would eventually minister to the extinction of the office. On the contrary, their examination of home grown seed would be equally necessary as that of foreign production to ascertain its quality, stamp its character, and prevent the sale of unsound and unclean seed. For this purpose, they would be as indispensably requisite as the inspectors of our linen are, to hinder the abuses that would otherwise creep into this manufacture, and would ultimately invalidate its reputation.*

As a clue to direct their steps in tracing the disease of the flax plant, and consequently in leading to the means of prevention or of cure, I shall here offer a theory respecting its nature. The colouring matter in ripe flax, we have seen, consists in a species of resin; and resin, which yields much soot during combustion, appears to be oil rendered concrete by its combination with oxygen. Plants, we have also seen, may become hyperoxygenated, and consequently too great a quantity of oxygen may be added to the oil, which

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* They will find abundant references in this work, by resorting to which, they will acquire aids to carry them forward in the undertaking, particularly in the writings of Kirwan, Darwin, and Dundonald.

which will thus be rendered more susceptible of ignition; a process that may in part take place in the living plant, as it does in the dead one, by the joint action of heat and air. But, in the living plant, the vital principle resists the extension of the process throughout its substance, and confines the disease, like gangrene or canker in an animal body, to distinct spots or places, in which a degree of combustion may be supposed to occur.*

In the combustion of dead vegetable matter smoak is produced, and is accompanied with soot, partly composed of substances imperfectly burned, having escaped the action of the oxygen. Soot by analysis, yields an oil, insoluble in alcohol, an acid formed by the decomposition of mucilage, also volatile salts, such as carbonat of ammonia, and other neutral salts. That oxyd of carbon, called charcoal, is another state of vegetable substances produced by fire; and may be known by the following process: if the substance, supposed to be charcoal, be burned in contact with air, its acidifiable base attracts oxygen, and becomes a peculiar acid, which, with a certain portion of caloric, assumes a gaseous form. This elastic fluid is carbonic acid gas, or fixible air, in 100 parts of which are found 28 of carbon, 27 of oxygen, and an adequate but undecided share of caloric, or the matter of heat.

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* It has already been shewn, that the buff stains or iron-moulds in linen cloth proceed from a species of combustion, occasioned by the union of oxygen gas. This union in the dead vegetable substance, and the consequent combustion, seem to shed light on the conjecture, that the disease of the living plant, or *firing*, may be owing to a similar process. If combustion be the cause, the propriety of the term, *firing*, is obvious.

Now, may we suppose, that the specks or spots, in the reed of flax, are a species of soot, or a sort of charing which its fibres partially undergo? Or do they resemble in their nature another oxyd of carbon, named plumbago? This oxyd of carbon is found native, and originates from peculiar changes wrought in the ligneous part of vegetables, but not supposed to proceed from a process of combustion, and therefore may not be analogous to the matter of the flax spots. If, nevertheless, those spots be composed of a substance like plumbago, it may be discovered by heating some of the diseased matter in a retort with caustic alkali, in which case, the alkali effervesces, hydrogenous gas is formed, and the plumbago disappears. The small quantity of water in the salt is decomposed, from which comes the hydrogenous gas; and its oxygen combining with the carbon of the plumbago, carbonic acid is the result; which is the test required.

These ideas, however, are merely conjectural; having to regret the want of opportunity, since this train of thought occupied my mind, to treat the subject experimentally; and I am, moreover, apprehensive, that neither my time nor means will enable me hereafter to make amends for this lack of suitable evidence. Yet, as these conjectures seem to me not unfounded; and, as they may lead to something useful in a subject of national concern, I resolved to risk their appearance on this occasion; leaving it to men of more leisure and ingenuity to determine respecting their strength or weakness. Be this as it may, even in their present state, these conjectures appear calculated to promote the application of chemistry to agriculture, and in this point of view alone, they seem entitled to the liberal suffrages of scientific and public spirited men.